SCIENCE

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CONTENTS

MSS. intended for publication and books, etc., intended for review should be sent to Professor J. McKeen Cattell, Garrison-on-Hudson, N. Y.

FEDERAL FORESTRY[1]

THE part played by the nation in forestry must always be large. Here as in all other countries, the real development of forestry began when the government took up its practise. Even to-day some persons would leave the forests entirely to private owners; others insist that the public phases of forestry are altogether a state function and federal activities in this field uncalled for. Those who hold this view are usually either lukewarm concerning the need for forest conservation or opposed to restricting private activities.

National responsibility in forestry is perfectly clear-cut. There need be no confusion with an equally clear-cut responsibility of the states. And as to private forestry little of value has so far been done that has not been an outcome of public action through state or federal agencies, or both. It was the work of the federal government in placing its own forests under administration, its demonstration of fire protection and of conservative lumbering, its experimental and educational work, and its stimulus to our educational institutions to train and turn out a large body of foresters, which created the present wide interest in forestry and brought the efforts of other agencies into successful play. I do not mean in any way to overlook the splendid work of certain individual states like Pennsylvania and New York, which dates back many years. But that was localized in a few states. It required the nation itself to set in motion a national move-

[1] Address delivered at the Fifth National Conservation Congress, Washington, D. C., November 19, 1913.

ment. The national work will always be the backbone of American forestry, not trenching on or interfering with state work or individual efforts but serving as a demonstration of forest management on its own lands, a center of leadership, cooperation and assistance to state and private work, a means to handle interstate problems and coordinate the work of neighboring states, a guarantee that national needs which individual states can not meet will be provided for on a national scale.

Underlying the forestry problem are two fundamental considerations which should be emphasized and reiterated until thoroughly driven home. One is the public character of forestry. The public has a peculiar interest in the benefits of forestry. Both in the matter of a continued supply of forest products and in that of the conservation of water resources the public welfare is at stake. In each case purposes vital to the prosperity of the country can be accomplished only with the direct participation of the public. Private owners will secure results only on a limited scale in the long run on their own initiative. It takes too long, 50 to 200 years, to grow a crop of timber trees. Most private owners in face of fire risk, bad tax laws and uncertain future markets will not make the necessary investments. Most lumbermen have bought their lands either to log or to speculate in the standing timber, not to grow trees for later generations. Nor will private owners make investments for general public benefits, as in watershed protection. If the public is to secure the benefits of forestry it must take the measures necessary to guarantee these results, and it must bear the cost of what it receives.

Closely related to the fact that forestry is in many aspects a public problem is the second of the fundamental considerations I wish to emphasize. Forestry requires stability of administrative policy and such permanence of ownership as will ensure it. Herein lies the difficulty of private forestry on a large scale. Timberland owners are interested in the protection of their standing timber merely as insurance. Most of them are not interested in forest production, or in protecting cut-over lands if that involves substantial annual charges and is not necessary in order to protect their remaining standing timber. As yet the problem of cut-over private lands is unsolved. It is now devolving on the state to aid in their protection from fire in the interest of its own citizens. It will require the utmost resources of state and federal government together to handle this problem of getting reasonable protection of private forests and permanent production of timber on cut-over lands. Stability of policy and permanence of ownership are essential to any successful attack on this great conservation problem.

This principle of stability of policy of administration is a large factor in successful handling of public property and has been consistently considered in the national forest work. I am frequently asked as I travel about the country whether I am going to make important changes in the forestry policy. I was asked that very often in 1910, when I first took office. I am asked it often this year. My answer is that what we are seeking is not changes but the development of a permanent public enterprise with consistent and stable policies. The national forests were set aside in the recognition that the bulk of these lands should be handled permanently under public protection and control. Provision was made for the acquisition of agricultural lands that might best be developed under private ownership, and such areas are now being classified and segregated from the forests very rapidly. The

successful handling of the national forests requires annual expenditures in administration and protection and in development of roads, trails, telephones, buildings and other improvements necessary for proper administration. We seek, therefore, as fast as possible to develop through classification the permanent boundaries of the forest land, and the management of it according to definite far-sighted plans that will make for the best results of all expenditures in the long run. The result sought is an efficient business administration, a proper and adequate forestry practise, and development of the public property in the interests of the people who own it. These simple principles have been kept in mind since the first organization of the work by Mr. Pinchot, who was more than any other one man responsible for what has been accomplished in forestry in this country.

The national forests have now been under administration fifteen years, and under the Forest Service for eight years. The aim of the present administration is not to overturn, but to take every possible step to increase efficiency of the organization, to adjust difficulties, and advance as fast as possible the purposes for which the national forests were established. Secretary Houston recently said to me regarding the national forests:

"Establish permanent boundaries. Classify your lands; segregate the agricultural land and fix right limits for what is needed as protective and productive forests. Develop permanent policies based on full recognition of lasting public interests, and settled forestry practise fitted to the individual needs of each forest and locality. Study efficiency; make any changes necessary for this purpose, but make no changes that are not clearly called for in the public interest. Carry out your plans for the development and increasing use of the forests; but above all, make each forest work for community upbuilding and local as well as general welfare. We must always have in mind the men and women who are building up a new country and laying the foundations for prosperous, thriving commonwealths. We must try to study their needs and see where and how the forests can help them. But we must not cease to guard effectively against the evils of private privilege and monopolistic control of resources now the property of the public."

The first important result of national forestry is a demonstration that the forests can be protected from fire. It was only a few years ago that many asserted this to be impossible. In the northwest the smoke season was as inevitable as the rainy season of winter, and this was not merely the result of clearing land but from forest fires. It is only recently that our own forest officers have regarded lookout stations as feasible in certain places; for lookout stations are useless if smoke hides the view. This year has been the worst in many respects of all years in California because of the frequency of lightning fires. Yet the lookout stations on only two forests, and then only for a short time, were out of commission because of smoke; and the smoke came from fires on private lands. This year in California there were over 1,100 fires on the timbered areas. These were kept down to an average of a little over 20 acres per fire. This was done by an effective fire organization and through the means of the trails, telephones and lookout system. In one storm lightning set over 20 fires on one forest. It takes swift and efficient work to handle such a situation. The results so far attained show that fires can be mastered. But it is necessary first to put the forest in a condition to enable

the force to prevent fires, to detect promptly those which start, and to reach them quickly. The Forest Service is developing a system of lookout stations, fire lines, trails, and telephone lines that ultimately will make the forests secure. Already the force is able to save every year property valued at many million dollars through the improvements so far built, although as yet only a beginning has been made. This work is carried on according to a definite plan, already projected in detail. Each year's work adds 2,500 miles of trails, 3,500 miles of telephones, and many lookouts and other improvements, progressing toward the final scheme. Until that is completed the forests can not be made entirely secure. With that development, the forest fires can be handled even in that exceptionally dry year that occasionally comes to every region.

This protection not only saves the trees from destruction or injury, but already the effect is shown in the restocking of many areas where the old fires had prevented reproduction. Personally, I had hardly expected that there would be so quick a response. But the results are now apparent to even a casual observer. More specifically, while previously the forests were going backward because of fires, there is now an annual gain through growth. This increase translated into dollars and cents is much greater than the total cost of protection and all other expenses of the forests.

The necessity to take immediate steps to prevent the public forests from being destroyed by fire has placed a large emphasis on the protective feature of the administration. The wise use of the forest resources in the development of industries and in building up the country is essentially the real aim of maintaining the forests. Protection from destruction is a first essential; otherwise there would be no resources to use. But the purpose of the administration is not merely protective, but constructive. It is a favorite theme of the opponents of the national forest system to represent the forests as a separate federal domain, held for the use of future generations or for persons other than those now living in the region in which the forests are situated. Such statements are not only contrary to the spirit of the administration of the forests, but are disproved by the results already being secured. The aim is to make the forests count in the highest possible measure in the industrial upbuilding of the local communities, at the same time that they serve their broader public functions. In classifying the agricultural lands the aim is to get people to make permanent homes in the forests. Every consideration in the development of the states and in the upbuilding of the forests themselves makes for the encouragement of a greater local population. When there are people to create a demand for the timber and other resources, the real development of the forest becomes possible, and the forest begins to render its greatest service.

To encourage this development the Forest Service is promoting the sale of its ripe timber to build up local lumber industries of a permanent character; it is opening to entry land chiefly adapted to agriculture; it is further helping the settler by providing free such timber as he needs and protecting him in the use of the range needed for his stock; and in every way it undertakes to make the forests of public service and the country in the long run a better place for men and women to live in.

That a long step has already been taken toward this end is indicated by the very extraordinary change in sentiment in the west in the last few years. I have this year

been able to analyze in detail the sentiment on the individual forests and now know just where opposition in each case exists and the extent to which the work of the federal government is valued. I have been astonished at the overwhelming preponderance of sentiment among the local communities in favor of the forest system. Frequently there are objections to certain regulations, or difficulty and friction in specific transactions. But every year these local troubles are being adjusted on the ground. There is still definite opposition to the forest system and the principles of our administration from certain groups, and certain interests. There are still certain water power interests which are carrying on a fight against the Forest Service. Many speculative interests oppose the forest system because the resources are not open to private acquisition under the general land laws. Certain men are opposed to the national forests because they can not secure privileges that would be possible if the forests were unprotected. For example, in the southwest I find a well defined opposition among those who desire to run herds of goats on the forests without restriction. The desire to secure valuable timber for speculation is now, and always will be, a source of opposition to the public control of our forests.

One proof of the present favorable sentiment is the fact that there are now relatively few breaches of the regulations. For example, in the fourth administrative district, which includes Utah, Nevada, northern Arizona, southern Idaho and southwestern Wyoming, over 11,000 permits were issued last year, each involving some regulation. There were only 35 cases of trespass, about half of which were innocent and the majority of the remainder not very important. Such a record would be absolutely impossible if the people themselves were not right behind the regulations. In other words, it was public sentiment that made it possible to carry out the procedure with such success.

In the national forest districts it is now seen that the aim is to make the national forests serviceable at present as well as in the future, and people are cooperating more and more with the government to make the local administration successful.

In the east the work of the federal government is to-day far more effective than ever before. The establishment of national forests under the provisions of the Weeks law is accomplishing many results not anticipated even by its most earnest advocates. The purchase of lands on important watersheds in the White Mountains and southern Appalachians is steadily progressing. Already contracts for over 700,000 acres have been approved by the National Forest Reservation Commission. These lands are located on the most important watersheds and have been secured at prices representing their actual value, the average being $5.07 per acre. It has already been demonstrated that the building up of national forests by purchase and at reasonable prices is practicable.

The first effect of these purchases has been an educational one. The wide interest in the work has resulted in an awakened appreciation of forest protection and forestry wherever the government has been examining land for purchase. Cooperation in forestry between the government and the states has received a great stimulus. The actual annual saving from loss on areas protected from fire directly as a result of the Weeks law, on private as well as public property, would amount to a very large aggregate sum. In short, the Weeks law is now yielding results which fully justify the new policy which it established.

The nation's interest in the success of the forestry movement is very great; the contribution of the nation through federal agencies should be correspondingly liberal. Let the federal government assume its full responsibilities of leadership, assistance and cooperation, and our forest problem will be on the way to certain solution.

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Federal Forest Service,
Washington, D. C.

THE ESSENTIALS OF AN EDUCATION[1]

The official recognition of the subject of mental hygiene by the International Congress on School Hygiene is an important event, indicating formal assent to the principle that thought and conduct can only be intelligently discussed when considered in relation to all other forms of human activity. After having been perpetuated for centuries by mechanical repetition, the phrase "a sound mind in a sound body" has suddenly acquired a vital meaning for our civilization.

Although the honor of presiding at this symposium upon mental hygiene is deeply appreciated by me, I am keenly alive to the fact that the force and set of the currents in this movement are already so strong that the question of merit in the selection of your chairman is almost a negligible factor.

The common elementary truths of daily life are frequently either ignored or forgotten. "We go to Switzerland," said Lowell, "to learn the sun rises and to Italy to find out the sky is blue." In considering what the aims and methods of obtaining an education should be, our attention is so often fixed upon remote unattainable ideals that the really essential factors in the problem are overlooked. The cause of idealism in education, as well as in other matters, is often best served by those who take a direct practical interest in the problems of everyday life. It is an exceedingly dangerous form of sophistry which has recently been promulgated that tends to cast suspicions upon any system of education reflecting either utility of purpose or immediate practicability of application. The value of ideals is commensurate with their practical usefulness, unless we assume with the Buddhist that the *summum bonum* of human existence is found in passive contemplation. Mr. Snedden, the Massachusetts commissioner of education, in his recent book[2] affirms that many of our academic studies are organized and presented too much with reference to their pure aspects —that is, without regard to their application in contemporary life and activity.

Clear ideas in regard to some of the chief characteristics of the educational process will be of material assistance in restating the entire problem of educational reform in terms that shall be favorable, and not antagonistic to a rational solution. The successful execution of this plan will ensure the perpetuation of popular government. A distinguished writer recently indicated the direction in which all our hopes for the improvement of political and social conditions lie by affirming "the most important problem of democracy is the education of the citizen."

No intelligent person would dissent from the view that the process of education is intended to direct or shape the activities of living beings. Unfortunately, the tendency of the human mind either to contemplate events in the past or to speculate about the future has hitherto left man little time or opportunity to study his own activities or

[1] Chairman's address, "Symposium on Mental Hygiene," Fourth International Congress on School Hygiene, Buffalo, August 25 to 30, 1913.

[2] "Education Readjustment," Houghton, Mifflin Co., 1913.

to think about his immediate needs. Even in our universities comparatively little interest is given to the study of man as he lives, moves and has his being to-day.

The process of education should prepare students for life and not convert them into receptacles for storing up miscellaneous forms of information. If we succeed in grasping the vital principle concerned in this distinction, we see that the discussion of such questions as whether science or the humanities have the greater educational value are as absurd and futile as Don Quixote's attacks upon the windmills. The problems of "living" can not be expressed in pedagogical phraseology. An intelligent discussion of the activities of living beings and the methods to be used in directing them is only possible in terms of biology.

Education or, as it has often been defined, the intelligent direction of human activities, is a process, the successful adaptation of which to human needs should be measured by the effects on the entire life of the individual, and not merely by results observed during the very restricted period beginning with the entrance into school and ending upon graduation from college.

When judged from this standpoint, education is the intelligent assistance given to an individual to estimate his own capacity to adjust life at the level within which he may live happily and successfully.

As a corollary to these premises, it becomes obvious that those deserving the title of educators should have some knowledge of the fundamental characteristics of living beings. Man, as we all know, is an exceedingly complex organism, made up of many different parts or organs adapted for special vital functions. The harmonious interaction of all these organs, and the contact of the individual with his environment, are established and maintained by the sense-organs, as well as the brain and nervous system. Interference with the function of a sense organ, the internal viscera, or the brain and nervous system, causes an imperfect adjustment of the individual's life and a condition called disease is the result.

The brain and nervous system are important parts in the mechanism of adjustment, but the trends given to our activities are largely determined by other organs. The distinctive mental qualities of men and women, as reflected in the personality, are therefore not only due to differences in the brain and nervous system, but depend upon the influence exerted upon the processes of adjustment by internal organs. This fact has recently received striking experimental confirmation. Without entering further into the discussion of this interesting question, we merely wish to emphasize the necessity of considering all questions relating to the education of the personality from the broad biological standpoint. The personality represents the focus of all our activities and therefore if we desire to study its genesis and to direct its development we should not restrict our view of education to a psychologic basis. It is one task, and a very important one, to attempt to analyze mental traits, but it is quite another to determine whether specific personal characteristics are not due to excessive secretion of the thyroid gland, a dilated heart, adenoids, defective vision, et cetera. The educator should be quick to avail himself of every advance made in psychology, but these facts must be supplemented by a still broader knowledge of living beings.

The biological conception of education simplifies nomenclature. We have only two conditions to consider: first, that of relatively perfect adjustment of the individual, or health, and defective adaptation, or disease. Incidentally this has a great advantage, as the word insanity at once drops out of use, and the problem of "mental defi-

ciency'' to which so much attention is now being directed is correctly valued, becoming merely one phase of the great problem of ''unsuccessful life-adjustments.''

It would be impossible, within reasonable limits, to discuss all the factors which determine successful or unsuccessful adjustment, and we shall at once dismiss from consideration those commonly designated as hereditary, but we can not refrain from expressing the hope that the discussions upon this important point should not be expressed in terms of such apodictic certitude as to lead a more or less credulous public to believe it is futile to attempt to make the lives of those whose ancestry has not received eugenic sanction happier and more effective.

Successful adjustment in life depends upon the character of the habit-reactions. The formation of good habits predicates the existence of a sound mind and sound body. If an individual does not possess the latter, it is the duty of the educator to give assistance in the effort made to compensate for defective reactions, the result of physical deformities, by compensatory mechanisms. Our sympathy is quickly aroused and we readily give assistance to the cripple who tries to cross a crowded thoroughfare, but how little effort do we take to prevent the tragedies occurring as the result of the encouragement given to the motley throngs driven helter-skelter through schools, colleges and universities, stimulated by false hopes and ambitions to adjust their activities at levels which are sure to precipitate disaster.

A recent writer in the *Atlantic Monthly* has called attention to the enormous waste of time and energy, as well as of money, due to sentimentality. A large part of the present educational curriculum shows plainly the dangers to our national life and the economic loss entailed by the perpetuation of a curriculum in schools and colleges which is an expression of sentiment rather than of reason. Ignorance, as well as pride in our creations have led us to count the successes and to disregard the failures of the system. In round numbers there are 187,000 patients in hospitals for the insane and 183,000 students in colleges and universities. It is known that there are a large number in every community suffering from well-marked psychoses. In the state of New York the estimate has been made that at least 1,800 or 2,000 patients afflicted with alienation should, if provisions existed, be brought under supervision in hospitals.

In other states the proportion of those in need of hospital treatment is greater, so that if adequate provision existed throughout the country the numbers of this army would be increased probably to 250,000. The patients in institutions, as a rule, represent the severe or later stages of imperfect life-adjustments. If we add to this number the list of those suffering from nervous and mental breakdowns in incipient stages, the so-called ''failures'' in life, and the imperfect adjustments grouped together in the criminal classes, it is evident the successes of our present educational system, as compared with its failures, represent relatively a very small number. In general, we recognize the principle that those are the best guardians of the body in health who have some understanding of the nature of disease. One of the chief aims of the educator should be to assist students in their efforts to become the possessors of sound minds, in sound bodies, and therefore a comprehensive understanding of the biological laws determining human thought and behavior is necessary for every teacher.

Progress in educational, as in all other reforms, is necessarily slow, but the program may be made a practical one from which definite results shall be expected.

1. In the first place it is desirable that the public should be accustomed to the discussion of educational problems in terms adapted to the description of the activities of human beings. With the more general acceptance of the biological view of the subject and the consequent elevation of the teacher from pedagogue to become an adviser and director in all questions relating to the art of living successfully, there would be increased appreciation of the honor and dignity of this profession, and greater possibility of obtaining financial recompense in proportion to the value of service rendered to the community.

2. There should be as rapid an extension as possible of special classes and schools for those whose capacity to adjust at the higher levels of activity is impaired. Provision should also be made, not only for the cases of imperfect intellectual adaptation, but for those in whom the emotional life abnormally dominates reason.

3. The insistence in schools, as well as in the higher institutions of learning, upon the cardinal principle that the acquisition of good habits, and not of information, should be the final test of a successful education. Think of the remarkable gain to our civilization if children were taught fewer subjects, but were given assistance in acquiring good postural habits, were taught to breathe deeply, to speak without a nasal twang, to eat slowly, and were not allowed to imitate the nervous habits of parents or teachers, or to crystallize into permanent form the undesirable reactions induced by fatigue or protracted study in poorly ventilated rooms. Good as well as bad habits are generally cumulative. Training the eye to see, the ear to hear, and the hands to perform the coordinated movements essential in the manual arts will lead to the formation of many of the mental mechanisms characteristic of the man of culture. Greater freedom from prejudice of creed and race, more rapid progress in the search for truth, would result if care were taken in the homes and schools to prevent the formation of those habit-reactions which give an abnormal degree of fixity to ideas and produces a state of mind described as stereophronesis.[3] The prophylactic treatment consists in an avoidance of intense emotional reactions, the cultivation of sense-perceptions, and the capacity to obey the three cardinal impulses essential for genuine temperance reform, "Stop, Look, Listen."

If attention should be placed upon the importance of habit-formation and directed away from futile academic discussion relating to the introduction of this or that variation in the curriculum of study, a great saving of time to students and teachers, and of money to the nation, would be the result. The American university to-day, in certain aspects, suggests a hospital to which students are sent in large numbers with the double purpose of correcting the bad mental habits acquired in homes or schools and of inoculating the undergraduates with the germs of culture.

The task is an impossible one and entails an enormous annual sacrifice of the best brains of the nation. Habits of work and the mental trends leading to the development of intellectual interests are formed during the school period and not later. If students were trained at home and at school to acquire good habits of work, they should pass directly from the high school to real university work, so that much work of the college could be readily eliminated. This change would at once set free the men now in our universities who, under the present archaic system, have become slaves to teach-

[3] This term was suggested by Professor Edward Capps as descriptive of the mechanisms underlying the "idée fixe."

ing, to prosecute research and to add to the store of our knowledge. The present tendency to ruthlessly sacrifice sums of money, as well as the energies of members of a university faculty in performing tasks which should be assigned to teachers in the elementary and primary schools, is a serious menace not only to the intellectual life, but to the mental health of the nation. The absurd pedagogical tasks imposed upon university professors of attempting to give to mature students the mental mechanisms characteristic of men of culture, which should have been acquired either at home or in the kindergarten, represent forms of servitude that should not be tolerated in these institutions.

4. As regards the actual training of teachers competent to approach the study of educational problems from the biological point of view, much can be accomplished by creating in the universities increased facilities for study in this direction.

The establishment of departments of biological psychology, independent of any direct affiliation with those of philosophy, is desirable. At present, philosophy and psychology suffer from the effects of an unnatural union continued merely out of respect for tradition, and a disinclination to do that which is right in the face of adverse criticism.

If the universities intend to become centers for the study of human activities with a view to making life pleasanter and more effective, they should renounce any half-hearted interest in the development of biological psychology as indicative of a lack of intelligent sympathetic appreciation interest in the solution of problems having a vital bearing upon the progress of our civilization. In universities where this division has already been accomplished by which philosophy and psychology have been set free to develop normally, it is to be hoped ample provision will soon be made for the establishment of biological psychology upon a basis indicating that at last human intelligence has awakened to appreciate "the true study of mankind is man."

In addition to the extension of present courses and facilities for training teachers, ample provision should be made for instruction along special lines in our medical schools, as has been suggested by Professor David Spence Hill; particularly in connection with the work in the psychiatric clinics. Instruction in this particular field should be directed to the demonstration of methods for studying the human individual and for giving teachers an opportunity to become familiar with the early symptoms of imperfect adjustment, and the treatment applicable to individual cases.

I have attempted to indicate a few of the essentials of an education when the process is considered as a means of directing the activities of living beings. Education is one of the youngest of all the arts. Its renaissance followed the birth of the biological sciences. Long held in bondage by those afflicted with an hypertrophied historical sense or cultural mysticism, its growth was retarded by man's whimsical and inconstant interest in the study of his own activities. If teachers and students were compelled to walk backwards with their gaze constantly fixed upon the monuments of the past it was no wonder they stumbled and often fell while climbing the mountains. The struggle to become free from the paralyzing influences of tradition and superstition continues, but hopes for progress and for the reduction of human inefficiency, waste and suffering depend primarily for their realization upon the recognition of the general biological principles which actually determine human life and human ideals.

Stewart Paton
Princeton, N. J.

ADDRESS BEFORE THE BIOLOGICAL DIVISION OF THE AMERICAN CHEMICAL SOCIETY[1]

GENTLEMEN, I did not come to Rochester with the intention of making a speech, but find—I am sorry to say—that Professor Chambers expects me to talk. He made the request—or, shall I say, demand—as we came into this room. I find that I am driven to the usual refuge of those who have to speak when they would rather be silent—that is, I will take refuge in the history of my subject.

This subject has, I think, some general interest because originally no very definite distinction was made between biochemistry and any other kind of chemistry. One of the first real biochemists was Lavoisier, whom all matter, whether living or dead, interested. He performed the first calorimetric experiments. He was the inventor of the ice calorimeter, and showed that animal heat was the result of oxidation. All the chemists of that generation and the immediately succeeding one did biochemical work. I need only cite Liebig, who is perhaps in some ways the greatest of all biochemists. Unfortunately, about the latter part of Liebig's life chemists lost interest in biochemistry. This was due very largely to the sudden and tremendous development of organic chemistry, which was brought about by the discoveries of men like Hofmann and Kekulé. It was so easy to make new synthetic substances and thereby gain a sort of immortality, even though the main result of putting a chlorine atom here and a bromine atom there was to fill up Beilstein. In consequence, thoroughly trained chemists did not busy themselves with subjects that were really important in the elucidation of that matter which is found in living organisms, and which forms the physiological basis of life. The scientists in biology and medicine needed such information. The chemists did not give it to them. Consequently, physicians and physiologists who were ill-equipped for chemical research were forced to carry forward the work of biochemistry. Though the net result of their work made decidedly for progress, only too often it created confusion and artificial difficulties. Even the best biochemists of those days make us wonder why they did not pursue their chemical investigations as far as the chemical methods of that day would permit. The answer is, I think in many cases, that they were not real chemists but physiologists with a chemical veneer. Fortunately, this has been changing during the past decade, largely owing to the work of Emil Fischer. While we recognize in him a master of chemical technique, we may be certain that in a measure, at any rate, the preeminent position which he occupies among the chemists of his time is due to his clear conception of the really most important work in organic chemistry along biochemical lines. Fortunately, more and more organic chemists are following in his footsteps, and are devoting their attention to substances which occur in living things. I wish here to make a plea for more of this sort of work in America. I believe that the rewards and recognition for knowledge of chemistry applied in biochemistry are great, because the work of the biochemist will be applauded not merely by chemists, but also by zoologists, botanists and physicians. A biochemist has a wider audience because his work presents a more general appeal than the work of organic chemists upon such subjects as dyestuffs and the like. Further, I wish to point out the value of instruction in allied subjects. Not every organic chemist can successfully attack all biochemical problems. Because his organic chemistry, other experience in physiology, and above all, experience in dealing with substances which do not crystallize, are necessary. In many cases it is difficult to conduct biochemical research because the biochemist must very frequently begin with the smears, which the organic chemist consigns preferably to the slop jar. While the things which will not crystallize interest less the organic chemist, they are the very classes of substances with which the biochemist must deal. Great care, great patience and a knowledge of colloids are required of the organic chemist who wishes to work in biochemistry, but I feel

[1] Given by the chairman, Rochester, N. Y., September 12, 1913.

confident that the reward for such men is great, not merely in pure science, but also in industries and in the arts.

The history of biochemistry in America is similar to that abroad. In America it developed first in the seventies and eighties in the medical schools of the country; and, at that time, it was controlled by physicians and physiologists abroad. The subject was narrowed to the consideration of biochemistry as affecting the life of man. That is to say, the chemical side of physiological processes of the human body together with such considerations of bacteriological chemistry as affect man in health and in disease. This phase of biochemistry is cared for very adequately and acceptably by the American Society of Biological Chemists, the first biochemical society to be formed in America.

The phase of biochemistry which the American Chemical Society can very naturally expect to encourage are quite distinct from the aims of the American Society of Biological Chemists. Our usefulness will include the biochemistry affecting agriculture, phytochemistry in particular, and such industrial processes as are based upon biochemical reactions. For example, the more exact study of the chemical composition of fruits, grains and food products. It must be admitted that, at present, we know only those chemical substances occurring in considerable amounts in such important grains as wheat and corn. The minor constituents in grains of much importance have not been identified with exactness. If we consider grains of less importance even this degree of knowledge can not be claimed.

Some of our most important modern industries, like those dealing with starch, artificial fabrics, leather tanning materials, glue and gelatin, meat packing and the flour-milling industry require biochemists, and we are now training men to deal with such practical problems.

If our society confines itself to the activities already mentioned, there still remains a wide field of biochemistry uncared for, the biochemistry of the lower animals. This part of the biochemical work will become a part of the work in the zoological societies of the country. My view is that three societies of biological chemistry can well exist in America without competing in any way and each one caring for a specific need. These would include the biochemistry of the higher animals and its application to medicine; the biochemistry of the lower animals, and biochemistry in its application to plants, agriculture and the industries.

Carl L. Alsberg

MEETING OF THE COMMITTEE ON POLICY OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

The committee on policy met at the Cosmos Club, Washington, on November 17, 1913, at 8 P.M., Chairman Minot presiding. Messrs. Fairchild, Nichols, Humphreys, Cattell and Howard were also present.

The permanent secretary made an ad interim report of progress, stating that, unexpectedly, news from the Pacific Coast Division had been delayed by reason of floods and that his office was not definitely informed of action taken by that committee. He stated that the committee having power to appoint the temporary secretary for the South had selected Dr. Robert M. Odgen, of the University of Tennessee, and that he had been actively engaged in the work since October 1, and a letter which he sent out to southern members was read. The report on membership showed a satisfactory increase. With regard to the Atlanta meeting, the permanent secretary stated that, owing to delay upon the part of the Atlanta local committee, the preliminary announcement was not yet in type but that he expected to be ready to mail it before the end of the month.

The arrangements for the Atlanta meeting were discussed and it was decided to have two evening lectures, complimentary to the citizens of Atlanta, one by Dr. C. W. Stiles, of the Public Health Service, on the Health of the Mother in the South, and one by Professor Charles E. Munroe, of the George Washington

University, on Explosives Made and Used in the South during the Civil War. It was decided to hold the retiring presidential address on Monday night, December 29.

A discussion as to the future meetings of the association was taken up and, on motion, it was resolved to recommend to the next general committee that Toronto be selected for the convocation week meeting of 1915–1916.

It was resolved that efforts be made to hold large representative convocation week meetings at four-year intervals, the first to be held in New York in 1916–1917 and the second in Chicago in 1920–1921.

The permanent secretary was ordered to report to the affiliated societies that the committee on policy has under consideration the advisability of meeting in 1917–1918 at Columbus, Urbana or Cincinnati, in 1918–1919 at Boston, and in 1919–1920 at St. Louis or Nashville.

On motion, the permanent secretary was instructed to inform the affiliated societies that the committee on policy has recommended that efforts be made to hold large convocation week meetings in New York in 1916–1917 and in Chicago in 1920–1921, and to inform the affiliated societies that he has been instructed to forward this information that the societies may plan accordingly.

On motion, the committee on organization and membership was authorized to examine into the desirability and feasibility of organizing local branches of the association.

On motion, it was resolved that the treasurer, in making re-investment of $20,000 of the permanent funds of the association under the authority of the resolution of the council of December 30, 1911, be authorized by the committee on policy to invest in the best interest-bearing securities permitted by the Massachusetts laws regulating the investment of trust funds and, further, in order to simplify the approval of the committee on policy, as provided for in the resolution, it was resolved that Messrs. Humphreys and Howard be appointed a sub-committee with power to act in approval for the committee on policy on the investments selected by the treasurer and to assist him in making the selections.

THE NEW YORK STATE MUSEUM

THE New York State Museum has recently acquired by gift and purchase a noteworthy series of collections representing the Iroquois and pre-Iroquois cultural relics from within the state. The O. C. Auringer collection from northeastern New York is especially interesting for its many ancient relics of Eskimauian type and early Algonkian occupation. These are principally from Glen Lake, Saratoga county.

The Raymond G. Dann collection is almost entirely from the historic Seneca village of Totiacton, in Monroe county. It is an interesting illustration of the articles used at the early contact period. Clay vessels and copper pots were found side by side together with very elaborate articles in bone and shell.

The R. D. Loveland and Charles P. Oatman collections from Jefferson county comprise extraordinary series of clay and stone pipes, and a large variety of bone implements and polished stone ceremonials. The collections contain objects from the Eskimauian and early Algonkian cultures, and of equal if not greater interest is the fine series illustrating the culture of the early Onondaga-Iroquois.

The Frederick H. Crofoot collection is from the Genesee valley and represents the various occupations of the middle portion of the valley. Many crude objects show an early and transient occupation, but in the collection are some remarkable specimens from the Iroquois and from the earlier mound-building people.

The Alva S. Reed collection, brought together from a site near Richmond Mills, Ontario county, represents the culture of a prehistoric Seneca village, one of the few found in that region.

The extensive series brought together by Professor Dwinel F. Thompson, of the Rensselaer Polytechnic Institute, is a typical assemblage of the cultural relics of the upper waters of the Hudson. It contains many valuable

specimens also from the lower Mohawk, including pipes and earthy vessels.

Other acquisitions in archeology and ethnology are under present consideration by the Museum, the plan being to illustrate as fully as practicable the aboriginal history of New York, the culture of the Iroquois and the peoples who preceded them.

The Museum has also acquired the very unusual collection of minerals from Orange county, N. Y., made by the late Silas A. Young from localities which are, for the most part, no longer productive; and also the last of the great collections of paleozoic fossils brought together by the Gebhard family through three generations from the classic Schoharie valley, a region which might appropriately be called the cradle of American stratigraphy.

SCIENTIFIC NOTES AND NEWS

The Hughes medal has been awarded by the Royal Society to Dr. Alexander Graham Bell.

Dr. Aubrey Strahan has been appointed director of the British Geological Survey and Museum in succession to Dr. J. J. H. Teall, who will retire on January 5.

Provost Edgar F. Smith, of the University of Pennsylvania, has been elected a member of the board of trustees of the Carnegie Foundation for the Advancement of Teaching to succeed Dr. Ira Remsen, recently president of the Johns Hopkins University.

Recently a movement was set on foot for the presentation to the Royal Society of a portrait of Dr. Alfred Russel Wallace, to be painted by Mr. J. Seymour Lucas, R.A. Professor Raphael Meldola, 6 Brunswick-square, W.C., and Professor E. B. Poulton, Wykeham House, Oxford, had undertaken to receive subscriptions. The proposal will not be abandoned in consequence of Dr. Wallace's death, though it will be necessary to have a posthumous portrait painted from a photograph.

The following is a list of those who have been recommended by the council of the Royal Society for election into the council at the anniversary meeting on December 1: *President*—Sir William Crookes; *Treasurer*—Sir Alfred Kempe; *Secretaries*—Sir John Bradford and Professor Arthur Schuster; *Foreign Secretary*—Dukinfield Henry Scott; Other members of the council—The Right Hon. Arthur James Balfour, Professor William Maddock Bayliss, Frank Watson Dyson, Henry J. H. Fenton, Professor William Gowland, Frederick Gowland Hopkins, Sir Joseph Larmor, Professor Charles H. Lees, Professor Ernest William MacBride, Professor Grafton Elliot Smith, Professor James Lorrain Smith, Sir John Thornycroft, Professor William Whitehead Watts, Alfred North Whitehead, Charles T. R. Wilson and Arthur Smith Woodward.

Dr. Filippi is to lead an Italian expedition to the Himalayas next summer. The explorer intends to spend the present autumn in Chinese Turkestan, carry on observations into Russian Turkestan, winter in Scardo in Baltistan, and early next spring travel to Leh by the inner Indus valley. From Leh the expedition will travel to the Karakoram to survey and map the unknown portion of the range between the Karakoram Pass and the Siachen glacier. The Government of India has subscribed £1,000 to the funds, and Major Woods of the Trigonometrical Survey will accompany the expedition.

Mr. F. T. Brooks, of Emmanuel College, Cambridge, is leaving England for the Federated Malay States in order to report to the government on fungoid diseases and whether anything can be done to arrest them. Mr. Brooks has received one year's leave of absence from the university.

Professor Josephine Tilden, of the department of botany, University of Minnesota, has returned from Australia and New Zealand, where she spent the past year in botanical research in the field and in collecting material in algology.

THE fourth lecture before the Harvey Society will be given at the New York Academy of Medicine, on Saturday evening, November 29, by Professor G. H. Parker, of Harvard University, on "The Nervous System, its Origin and Evolution."

PROFESSOR ELLSWORTH HUNTINGTON, of Yale University, delivered an illustrated lecture on "Changes of Climate during Historical Times," on November 3, before the New York Academy of Sciences, at the American Museum of Natural History.

PROFESSOR SHEPHERD IVORY FRANZ, scientific director and psychologist of the Government Hospital for the Insane, Washington, D. C., on November 15 addressed the Medical Society of St. Louis, on the subject of "Psychological Factors in Medical Practise."

REINHARD A. WETZEL was the guest of the research department of the General Electric Company, at Schenectady, on November 8. The subject of his address before the colloquium was "Einstein's Relativity Concepts as Interpreted by a Physical Model."

FOUR lectures on the "Aspects of Islamism" will be delivered at the University of Chicago near the end of the winter quarter by the professor of Arabic at the University of Leiden, Dr. Christian Snoucke Hurgronje.

A MEETING of the Pathological Society of Philadelphia was held on Thursday evening, November 20, at the College of Physicians, when there was a symposium on the subject of "Physical Growth and Mental Development." The speakers were as follows: Dr. H. H. Donaldson, of the Wistar Institute, "Studies on the Growth of the Central Nervous System"; Professor Bird T. Baldwin, of Swarthmore College, "The Normal Child; Its Physical Growth and Mental Development"; Professor Lightner Witmer, of the University of Pennsylvania, "Children with Mental Defects Distinguished from Mentally Defective Children." The discussion was opened by Professor James H. Leuba, of Bryn Mawr College, Dr. H. H. Goddard, of New Jersey Training School, Vineland, N. J., and Dr. Charles W. Burr, of Philadelphia.

THE Hermann Knapp Memorial Eye Hospital has opened its new building at the corner of Fifty-seventh Street and Tenth Avenue, New York. It was founded in 1869 by the late Dr. Hermann Knapp under the name of the New York Ophthalmic and Aural Institute, and for forty-four years it has been in uninterrupted activity at 44 and 46 East Twelfth Street. On the occasion of its removal to a new building in a new location, the board of trustees decided to change the name of the institution in honor of its founder. The new building is seven stories in height, fireproof throughout, and is equipped with all modern appliances for the treatment and study of diseases of the eye.

THE trustees of the American Medical Association have made a new appropriation for the Committee on Scientific Research. The committee has decided to use this money as far as possible to promote work in medical research where suitable conditions exist but where such work suffers for the lack of relatively small sums of money. Applications for grants are invited and may be sent to any member of the committee which consists of L. Hektoen, 1743 W. Harrison Street, Chicago; S. Flexner, Rockefeller Institute for Medical Research, New York, and Wm. Litterer, Vanderbilt University, Nashville, Tenn.

THE surgeon general of the army announces that preliminary examinations for appointment of first lieutenants in the Army Medical Corps will be held on January 19, 1914. Full information concerning these examinations can be procured upon application to the "Surgeon General, U. S. Army, Washington, D. C." The essential requirements to secure an invitation are that the applicant shall be a citizen of the United States, shall be between 22 and 30 years of age, a graduate of a medical school legally authorized to confer the degree of doctor of medicine, shall be of good moral character and habits, and shall have had at least one year's hospital training as an interne, after graduation. The examinations will be held simultaneously throughout the country at points where boards can be con-

vened. Due consideration will be given to localities from which applications are received, in order to lessen the traveling expenses of applicants as much as possible. In order to perfect all necessary arrangements for the examinations, applications must be completed and in possession of the adjutant general at least three weeks before the date of examination. Early attention is therefore enjoined upon all intending applicants. There are at present twenty-six vacancies in the medical corps of the army.

By invitation of the Comité des Forges de France, the autumn meeting next year of the British Iron and Steel Institute will be held in Paris, the dates of Friday and Saturday, September 18 and 19, having been provisionally fixed for the business sessions. The first half of the following week will be devoted to excursions to the chief iron-mining and manufacturing districts of France.

On November 24 the Portland Society of Natural History held a public meeting devoted to an informal observance of the seventieth anniversary of the day of its founding. The principal feature of the meeting was a historical address by the recording secretary, Major John M. Gould. Mr. Gould's term of life accords almost exactly with that of the existence of the society and its museum. He was a constant and interested visitor at the museum through his childhood and youth. In early manhood he became officially connected with the organization and has been actively connected with it to the present time. The society was founded during that period which brought forth numerous organizations of a similar nature, when Maine was a young state, recovering from the disadvantages of having long been a hostile frontier. In the outskirts of population, the society has lived through years of activity, and periods of adversity, twice having had its museum and its contents swept out of existence by fire. It still stands, true to the objects of its founders, "for the promotion of the study of natural history," with a substantial building for its museum and library.

Dr. J. M. G. Carter, of Los Angeles, Cal., has given his medical library and part of his scientific library to the University of Southern California.

Professor Julius Hann, the eminent climatologist of Vienna, wishes to find a purchaser for his meteorological library which has accumulated on his hands far beyond his power to take care of it properly. Owing to the fact that he has to live on a pension, since he was retired from active government service and is obliged to live in small quarters, the greater part of his library is already packed away in boxes. His great collection of books and separates will be a fine addition to the library of any institution that desires to complete its collection of books bearing on meteorology and climatology.

Professor Ernst Haeckel has written from Jena under the date of October 12, 1913, the following letter:

To My Friends, Pupils and Disciples:

I have from several sides been informed that a number of my friends, pupils and disciples intend to celebrate my eightieth birthday on the sixteenth of February, 1914, by presenting me with gifts about the form and nature of which different proposals have been made. Having repeatedly been honored on former occasions by such gifts, I beg *to abstain this time from all personal donations*, and to convey the amount of the means, destined for this purpose, to a foundation, which I should be glad to put to the disposal of the German Monists' Union. The wonderful development, which this modern union of culture has attained since its foundation seven years ago, the high importance which it has acquired for the promotion of a free and rational conception of life as well as for its practical application to a conduct of life of superior morals render its financial support by ampler means most desirable. The intended new "Ernst-Haeckel-Fund for Monism" shall incessantly further this work of culture of the free thought on the positive basis of natural science and furnish the necessary means to carry practically on its numerous important tasks. I anticipate my heartiest thanks to all my friends and comrades, who, by participation, will support the work of my long life.

On the first International Monists' Congress, which took place in September, 1911, in Ham-

burg, and which was such a splendid success, also because foreign countries took so numerously part in it—it became the principal aim to extend the German Monists' Union, and to make it an International Union. This Universal Monists' Union, representing an immense promotion of our high tasks of culture by uniting the free-thinkers of all countries, will be the more able to prove its importance practically, the more liberal also my friends abroad in all the continents will partake of the gifts for the new foundation.

THE new seven and one half-inch photographic telescope was placed in position in the Memorial Observatory of the Nantucket Maria Mitchell Association on November 15, the mounting and final adjustment by Alvan Clark and Son's Corporation, completing the work. The lens was made by T. Cooke & Sons, York, England. It has been subjected to various tests at Harvard College Observatory by the director, Dr. Edward C. Pickering, personally, and by his several assistants who have given it careful attention. Rev. Joel H. Metcalf, whose astronomical discoveries by means of photographs are well known, has also carefully examined its work. By all of these it is pronounced good. The Nantucket Observatory is now well equipped for photographic study of asteroids or other heavenly bodies.

THE London Astronomical Society opened on November 7 at Alton, Hants, a new observatory erected by one of its members, Mr. James H. Worthington. The site selected is over 600 feet above sea level, near the Melstead Station. Here Mr. Worthington has erected what, both in finish of instruments and in general facilities, is said to be the finest private observatory in England. It is more than 20 miles from any manufacturing town, and the atmosphere is not affected by any strong artificial lighting. There are altogether six telescopes. The two largest are under domes 24 feet and 22 feet in diameter, respectively, and are a 20 inch reflector and a 10 inch refractor.

STATISTICS of the fertilizer industry in the United States for 1909 are presented in detail in a bulletin soon to be issued by the Bureau of the Census. It was prepared under the direction of W. M. Steuart, chief statistician for manufactures. The report covers establishments making artificial fertilizers, the products being ordinarily ready for use without being subjected to further treatment. The production of certain kinds of products which are used more or less exclusively for fertilizing without further manufacture is not covered by this report. The raw materials used by fertilizer factories include animal, vegetable and mineral products, while sulphuric and other acids are employed extensively in the treatment of the basic materials. The finished products include a variety of classes, such as "complete" fertilizers, which consist of a mixture of superphosphates with both potash and ammoniates, superphosphates with or without ammoniates, concentrated phosphates, and other minor classes. The total number of establishments reported as engaged primarily in the manufacture of fertilizers in 1909 was 550, with a capital of $121,537,451. The number of persons engaged in the industry was 21,950, of whom 18,310 were wage earners. The total value of all products of the 550 establishments amounted to $103,960,213, of which $92,369,631 was the value of fertilizers proper, the amount of which was 5,240,164 tons. The sum of $11,882,815 was paid out for services, of which $7,477,179 was for wages. As judged by the amount expended for them, ammoniates, animal and vegetable, were the most important materials, followed by phosphate rock, potash salts, superphosphates, nitrate of soda, ammonium sulphates, sulphuric acid, fish, pyrites, and kainit in the order named. The cost of materials aggregated $55,360,423 in 1909, $28,975,713 in 1904, and $23,454,126 in 1899. Of these respective totals, the cost of ammoniates formed 42.4 per cent. in 1899 as compared with 34.2 per cent. in 1904 and 29 per cent. in 1909. The cost of phosphate rock shows only slight proportionate changes; it constituted 15.2 per cent. of the total of the specific materials in 1899, 14.6 per cent. in 1904, and 15.6 per cent. in 1909. The cost of potash salts represented 13.2 per cent., 12.4 per cent. and 13.2 per cent. of the total for the

respective years; and the aggregate cost of sulphuric acid and pyrites and sulphur constituted 13.2 per cent. of the total in 1899, 11 per cent. in 1904, and 11.2 per cent. in 1909. All fertilizer establishments manufacturing sulphuric acid employed the chamber process, sixteen using the Hoffman intensifier system, eleven the Pratt, nine the Gilchrist, three the Meyer tangential system, and one the Luney. The manufacture, for consumption in their own works, of 1,826,358 tons of acid phosphate was reported by establishments engaged primarily in the fertilizer industry, and 12,507 tons were made and consumed by establishments manufacturing fertilizers as a subsidiary product.

All records have been broken in the great mineral production of the United States for the year 1912. The year 1907 has heretofore been the banner year of American mineral output, with a total value of $2,072,666,639, but even this great figure was exceeded in 1912 by over $170,000,000. As compared with 1911, the increase in 1912 is $316,098,198, or 16.40 per cent. These figures are shown in a summary of the mineral production of the United States for 1912, compiled by W. T. Thom, of the United States Geological Survey, now in press. As heretofore, iron and coal are the most important of our mineral products. The value of iron (pig iron being the basis of valuation) in 1912 was $420,563,388; the value of coal was $695,606,071. The value of the fuels—coal, natural gas and petroleum—increased from $835,231,497 in 1911 to $943,972,362 in 1912, a gain of $108,740,865. Coal showed an increase in value of $60,040,860, from $626,565,211 in 1911 to $695,606,071 in 1912. The production of metals increased in value $186,571,303, from $680,531,782 in 1911 to $867,103,085 in 1912. The nonmetals increased $129,276,895, from $1,246,750,346 in 1911 to $1,376,027,241 in 1912. The unspecified products, including cadmium, selenium, rutile, uranium, vanadium and other minerals, valued at $500,000, increased $250,000, bringing the total value of the mineral production for 1912 up to $2,243,630,326. The production of pig iron in 1912 gained more than $93,000,000, or 28 per cent.; ferro-alloys gained nearly $4,000,000, or about 46 per cent.; silver gained more than $6,000,000, or 20 per cent.; copper gained about $68,000,000, or nearly 50 per cent.; zinc gained nearly $14,000,000, or 44 per cent., and aluminum gained nearly $4,000,000, or 47 per cent. Gold, which lost about $3,500,000, was the only important metal to show a decrease. Among the nonmetals bituminous coal gained approximately $67,000,000, or about 15 per cent.; anthracite coal gained more than $2,000,000; natural gas gained almost $10,000,000, or 13 per cent.; petroleum gained nearly $30,000,000, or 22 per cent.; clay products gained more than $10,000,000, or 6.5 per cent., and sulphuric acid from copper and zinc smelters (a product mined as it were out of the air and changed from a destructive waste to an absolute gain) increased $1,500,000, or 55 per cent.

UNIVERSITY AND EDUCATIONAL NEWS

An anonymous gift of $100,000 has been made to Wellesley College. The money was given towards the million-dollar fund which the college is trying to raise as an endowment. The total amount obtained thus far is $453,000.

Yale University has received a gift of $50,000 from Mr. Charles H. Pine, of Ansonia, Conn., to be used for scholarships under terms to be announced later.

Dr. Francis Gray Smart, of Tunbridge Wells, has left £10,000 to Gonville and Caius College, Cambridge, for two "Frank Smart Studentships" in natural history or botany, and if this sum shall be more than sufficient to provide for these studentships the balance is to be used to promote the study of these subjects in that college.

Mr. Otto Beit has given £2,000 to Cambridge University for a library of German books, together with £1,000, of which the income is to be devoted to additions.

The certificated teachers of Herefordshire have decided to take action in a body with a view to compelling the education authority to redress the grievances from which they allege

they suffer. The first group of about 100 resignations has been sent in to terminate on January 31, 1914, these being resignations of headmasters and headmistresses only. For various reasons the remainder of the resignations are being delayed for consideration by the executive of the National Union of Teachers.

AT the University of Chicago, Elbert Clark has been appointed instructor in anatomy, and Cora C. Colburn, instructor in home economics.

MR. J. H. MUNCIE, assistant pathologist at the Ohio Agricultural Experiment Station at Wooster, Ohio, has been appointed assistant in plant pathology at the Michigan Agricultural College, beginning with November 17.

AT the Worcester Polytechnic Institute Assistant Professors D. L. Gallup and Frederic Bonnet, Jr., have been advanced to full professorships in gas engineering and chemistry, respectively. Dr. D. F. Calhane, instructor in industrial and electro-chemistry, has been appointed assistant professor in his department. P. W. Brouwers, '13, returns to the institute as instructor in mathematics, and G. S. Simpson, who graduated from the University of Maine last June, becomes assistant in chemistry, replacing E. B. Peck, who has taken up a course of graduate work at the Massachusetts Institute of Technology.

THE University of Minnesota added to its scientific faculties, this year, the following new members: Dr. E. P. Lyon as dean of the College of Medicine; as professors: Frederick J. Alway in agriculture, Josephine T. Berry in home economics, Arthur D. Hirschfelder in medicine, C. M. Jackson in medicine, F. M. Mann in architectural engineering, Adolph F. Meyer in engineering, Roscoe W. Thatcher in agriculture, George T. Young in mining, and T. B. Hutcheson in agriculture; as assistant professors: Alva Hartley Benton in agriculture, W. H. Brierly in agriculture, Robert C. Dahlberg in agriculture, R. L. Donovan in agriculture, Robert A. Hall in medicine, Estelle L. Jensen in agriculture, Francis Jager in agriculture, R. S. Mackintosh in agriculture, T. B. McCulloch in agriculture, Peter J. Olson in agriculture, C. C. Palmar in agriculture, C. J. Posey in geology, Richard Wellington in agriculture and George A. Works in agriculture; as instructors: George D. Allen in animal biology, W. O. Beal in astronomy, E. C. Davis in agriculture, R. Dietrichson in chemistry, John T. E. Dinwoodie in agriculture, Albert M. Gilbertson in anthropology, Julian H. Gist in agriculture, Alex. R. Hall in medicine, Arthur T. Henrici in medicine, R. C. Jones in engineering, F. B. Kingsbury in medicine, W. Kritchevsky in chemistry, H. J. Leonard in dentistry, Mabel McDowell in agriculture, W. L. Miser in mathematics, Agnes Morton in agriculture, D. O. Ostergren in dentistry, Rollin M. Pease in agriculture, R. M. Peterson in agriculture, E. R. Pinney in dentistry, A. C. Potter in medicine, C. H. Rogers in pharmacy, C. O. Rost in agriculture, H. C. Samuels in dentistry, J. F. Shellman in dentistry, E. K. Strachan in chemistry, H. M. Sheffer in psychology, Frank Smithey in medicine, Mabel Barbara Trilling in agriculture, Grace T. Williams in agriculture, Robert Wilson in agriculture and J. J. Willaman in agriculture.

DURING the past year the following appointments have been made for persons who have graduated at the University of Illinois or who have been there within two years as graduate students in chemistry.

J. E. Bell, instructor in chemistry, University of Washington, Seattle, Wash.

R. A. Dutcher, instructor in agricultural chemistry, Agriculture College, Corvallis, Oregon.

J. E. Egan, assistant professor of chemistry, Miami University, Oxford, Ohio.

H. B. Gordon, assistant professor, Agricultural and Mechanical College of Texas, College Station, Texas.

L. R. Littleton, professor of chemistry, Emory and Henry College, Emory, Virginia.

W. S. Long, assistant professor of chemistry, in charge of the food laboratory, Lawrence, Kansas.

C. Ferdinand Nelson, assistant professor of physiological chemistry, University of Kansas, Lawrence, Kansas.

L. F. Nickell, instructor in chemistry, Washington University, St. Louis, Missouri.

H. L. Olin, instructor in chemistry, Vassar College, Poughkeepsie, N. Y.

R. S. Potter, research assistant, Agricultural Experiment Station, Iowa State College, Ames, Iowa.

E. K. Strachan, instructor in chemistry, University of Minnesota, Minneapolis, Minn.

G. Y. Williams, associate professor of chemistry and acting head of the chemistry department in the State University of Oklahoma, Norman, Oklahoma.

P. S. Woodward, instructor, Georgia School of Technology, Atlanta, Georgia.

The electors to the Waynflete professorship of physiology at Oxford, vacant by the death of Dr. Francis Gotch, have elected Dr. Charles Scott Sherrington. Dr. Sherrington succeeded Dr. Gotch as Holt professor of physiology at the University of Liverpool in 1895, when Dr. Gotch was called to Oxford.

DISCUSSION AND CORRESPONDENCE

MATHEMATICAL DEFINITIONS IN THE NEW STANDARD DICTIONARY

Funk and Wagnalls's "New Standard Dictionary of the English Language," 1913, has many merits and will doubtless be used very extensively. It is, therefore, of special importance to direct public attention to the fact that this dictionary is not reliable as regards definitions of mathematical terms. Some of these definitions will doubtless interest even those who remember only a little of their mathematics, as they relate to elementary matters and are so evidently incorrect. The following list of examples could easily have been extended, but it is believed that it will not require many examples of this type to convince the reader.

Under the term *algebra* it is stated that the infinitesimal calculus and the theory of functions may be classed among "the principal branches of algebra." A hundred years ago such a statement might have appeared proper, but it is not in accord with any of the classifications which have been extensively adopted in recent years, such as those employed in the International Catalogue of Scientific Literature and in the large mathematical encyclopedias which are in the course of publication. In fact, the infinitesimal calculus and the theory of functions are generally regarded as branches of analysis.

The explanations which follow the term *arithmetic* include the statement that the early Pythagoreans first studied arithmetic. On the contrary, it is well known that the ancient Babylonians and Egyptians made considerable use of elementary arithmetic, as may be seen from the extensive mathematical tables of the ancient Babylonians and the large collection of examples by the Egyptian scribe Ahmes. Possibly the early Pythagoreans might be regarded as the first workers in higher arithmetic or the theory of numbers.

An instance of a statement which is more evidently incorrect appears under the term *dimension*. It is here stated that four-dimensional space may be regarded as a hypothetical conception to explain equations of the fourth degree in analytical geometry. As a matter of fact an equation of any degree in two variables may be represented geometrically in the plane. It is the number of the variables and not the *degree* of an equation which corresponds to the number of dimensions required for its representation.

Under the term *equation* it is stated that an abelian equation is an equation "all of whose roots are rational functions of one or more of the roots." It is well known that the roots of non-abelian equations may also be rational functions of each other. In an abelian equation we must have the additional condition that its group is commutative.

A fractional function is defined, under the term *function*, as one whose variable appears only in its denominator; and a *Galois resolvent* is said to be "that resolvent of an equation whose roots remain the same when the group of the equation is permuted in any way whatever." It would be interesting to know something about the new theory of permuting the group of an equation. Unfortunately there seems to be no clue in this dictionary as regards the possible meaning of this term.

The most original definitions seem to appear under the term *group*. A complete group is defined as one in which no self-conjugate operations are possible besides the iden-

tity. According to this definition every alternating group whose degree exceeds 3 is complete, while none of these groups is complete according to the definitions of this term given elsewhere. A still more original and more mysterious definition under this term relates to the regular group. It is stated that this is "a transitive group whose order is the same as that of the letter on which it is made."

It is very difficult to see how any one can discover any meaning whatever in such a definition. To make a group on a letter is a process which seems to have been foreign to the literature of this subject. A large number of almost equally vague statements occur under other terms. For instance, under the term *number* it is stated that an irrational number is "a definite number not expressible in a definite number of digits," and a congruence group is defined as a group made up of replacements.

It may probably be assumed that all mathematicians who read these few citations will agree that American mathematicians have good reason to protest against such a butchery of their subject in a popular work of reference. Those who desire more evidence can easily obtain it by consulting this dictionary for the definitions of the following terms: analogy, angle—especially angle of elevation and angle of depression, automorphic, fraction, matrix, mathematical and variable.

G. A. MILLER

UNIVERSITY OF ILLINOIS

A REPLY TO DR. HERON'S STRICTURES

THE all-too-familiar "blessings" of Professor Karl Pearson upon "Mendelians" have recently been continued by his understudy, Dr. David Heron, and directed toward American work in eugenics in general and that of the undersigned in particular. Like my colleagues in this country I should have remained silent under the attacks, knowing that discriminating men of science in this country as well as in England recognize their true animus and that they lie outside the pale of science. But the notoriety given in a daily paper to the publication of Heron and to a "defence" based upon an interview with me by a reporter of the paper lead me to make a brief reply.

I shall not attempt now to answer all the scores of trivial points of criticism made by Dr. Heron, but shall consider only the paper on heredity of epilepsy by Dr. David F. Weeks and myself, which he singles out for special attack. The numerous "errors" to which he calls attention fall for the most part into three categories, based on misunderstanding so gross on the critic's part as to render it difficult to believe that they are not intentional. First, Dr. Heron seems to assume that whenever a symbol in a pedigree chart is not accompanied on the chart by some special description it stands for a person about whom nothing is known. He calls attention to numerous cases where, notwithstanding, the corresponding individual is described in the text. The assumption is a gross error. The chart shows mainly the interrelationship of individuals and indicates only certain traits. Second, Dr. Heron catalogues, with infinite pains, "errors" in citing the case number. Here he has fallen into a trap which the authors unconsciously prepared for him. To avoid the possibility that a person who is not authorized should connect an individual at the institution with his family history it was decided to apply alterations to the case numbers which enable the authors, but not the ordinary reader, to identify the case. None of the "errors" are such as would prevent the use of the numbers by the authors and they could be of no scientific use to others. Dr. Heron used them merely for criticism. Had we anticipated that there was anywhere a man of science with such abundant leisure, we should have published a warning that the reference numbers were for the sake of identification by the authors and not for scientific study. Third, in our tables we analyzed the traits of the "children" into ten columns, but condensed those of the father's sibs, etc., into 5 columns to save space; in some cases father and father's sibs, etc., appear as "children" and the classification is accordingly expanded from 5 to 10 categories. This, of course, is obvious to any intelligent

reader; but it serves our critic to swell the accumulation of details for his contention that our work is careless because the same fraternity is described by the use of different words in different parts of the paper.

A critic who is guilty of such extensive stupid, captious and misleading criticism can hardly expect a scientific consideration of other points he raises of a more general sort. I fear it will be futile for a biologist to attempt to show to the "applied statistician" his errors. Genuine, scientific criticism has always been useful in the advancement of science, but friends of Galton must regard it as a tragedy that the fortune of one of the largest-minded and most fertile-minded men of science should be supporting a laboratory one of whose leading members spends much time making elaborate researches into his delusions concerning the blunders of others instead of making positive discoveries in a field where so little is known and where the need of utilizable knowledge is so great.

Chas. B. Davenport
Cold Spring Harbor, N. Y.,
November 10, 1913

SCIENTIFIC BOOKS

Mineral Deposits. By Waldemar Lindgren. New York, McGraw-Hill Co. Pp. v + 883, Figs. 257. 8vo. $5.00.

In the preparation of this invaluable treatise a great boon has been conferred by Professor Lindgren upon all geologists. The work is of interest not alone to those immediately engaged in mining, but to all who are concerned with the processes of mineral solution and deposition in the earth's crust. For those who have not followed from year to year the advances of observation and interpretation, many new and striking results will appear.

The author has brought exceptional preparation and experience to the task. An old Freiberger, he was grounded by one of the best of teachers, the late Professor A. W. Stelzner, in the "*Lehre*" or "lore" of ore-deposits, and learned of the applications of geology in the steadying atmosphere of an engineering school. Beginning in 1883 on the Transcontinental Survey of the Northern Pacific railroad, Mr. Lindgren entered the U. S. Geological Survey the next year, and has thus had nearly thirty years of study in the mining districts of America. Journeys in Australia and Europe have further amplified experience, and courses of instruction given by him at Stanford University and in the Massachusetts Institute of Technology have served to systematize and formulate conclusions. To all has been added a thorough scholarship and spirit of fairness, such that the resulting work is marked by all these characteristics. It is also the ripe fruition of a little school of American observers, whose views have found special expression in the magazine *Economic Geology.*

The book is divisible into two parts. An introductory one of about one fifth the total embraces the general chemical and structural principles on which the remainder is based. The major portion is thus devoted to a review and discussion of the types of mineral deposits whose scheme of classification is at once the climax of the first part and the skeleton of the second. As the title implies, the work takes up "mineral deposits" rather than "ore deposits." The title makes logical and consistent the treatment both of the deposits with the distinctive metals and those with non-metals. It enables the author to have freer scope in that questions of profitable working are less involved. The title is a little over-inclusive for the subject-matter, because coal, our most important mineral deposit, is not mentioned, although a place for it is provided in the scheme of classification. Old associations were probably so strong with our author that coal, petroleum and natural gas faded from the field of view when actually writing.

In the introduction, water necessarily plays a very important part. Six extremely interesting chapters are devoted to it. For the greater number of mineral deposits water is quite correctly regarded as the all-important agent. Its composition, circulation, chemical reactions and amount are all reviewed. The question, may, however, be raised, whether, when the general shallow penetration of the meteoric

groundwaters into the crust of the earth is appreciated; when the great restrictions upon their actual amount which have been demonstrated in recent years are grasped in their full significance; and when the great depths to which many veins extend are kept before us; we may justifiably state, as on page 24: "However important these (*i. e.*, magmatic waters) may be in the formation of certain kinds of ore deposits, they are insignificant in quantity compared to the great circulation of atmospheric water." It sometimes seems to the reviewer that even while stating newer facts almost from force of habit we are inclined to reiterate older doctrines from beneath which the newer facts have largely removed the foundations. Had we known at the outset of the limited vertical distribution of the meteoric groundwaters and of their small amount, it is quite possible that we should have had a less firmly rooted faith in them as the *prima facie* source of deep-seated circulations, and would have given other kinds of water greater relative importance. The subject is, however, young, and a gradual modification of views may come in time as we escape the hypnotic influence of the past. Indeed, as we read Professor Lindgren's subsequent pages, and especially Chapter VI., we feel as if, when the actual phenomena were reviewed, the magmatic waters seemed of greater and greater importance. Indeed, who can affirm that the surface waters were not themselves once magmatic?

The introductory portion also contains valuable chapters on faults, folds, openings in rocks, textures of deposits and ore-shoots, on almost all of which Professor Lindgren has previously written in a most illuminating way. The classification of mineral deposits, which is to form the framework of the later pages, is introduced by a condensed review of other schemes and of agents.

The scheme of classification is the foundation of the treatise. It is fundamentally based on mechanical processes of concentration on the one side, and chemical, on the other. While these two have been emphasized in one way and another by earlier writers, no one else has so logically and completely carried out the chemical processes in determining the subgroups on the basis of temperature and pressure. The types of mineral deposits are, therefore, taken up in order, beginning with reactions at the surface at ordinary temperatures and pressures, passing to those in the rocks at greater and greater depths and terminating in the natural climax of those produced by processes of differentiation in magmas. Perhaps the question will arise in the minds of some, as to whether we are sufficiently well-informed regarding the temperatures and pressures at which minerals develop in order to make this grouping sound. The reply may be made, that the associations of minerals in the various types are in contrast; that we have learned much from their artificial production; and that the peculiar etch-figures afforded by quartz, a mineral of wide occurrence, and differing according to its crystallization above or below its conversion point of 575° C., have all given critical data now of great significance.

Professor Lindgren reviews practically all the famous mining districts of the world and in connection with them discusses with fullness and illuminating insight the questions of secondary enrichment, of persistence of mineral characters with depth, of contact zones, of magmatic segregations and of pegmatites. Indeed, no student of the subject can read these pages without feeling his interest quickened and his grasp of the causes which have led to the formation of mineral deposits greatly broadened. Professor Lindgren has, therefore, as stated in the opening sentence of this review, placed his colleagues and students everywhere under a great debt by the preparation of a masterly work.

J. F. KEMP

Der Mensch der Vorzeit. Von DR. HUGO OBERMAIER, Professor am internationalen "Institut de Paléontologie Humain," Paris. Mit 39 Tafeln, 12 Karten und 395 Textabbildungen. Allegemeine Verlags-gesellschaft, M. B. H., Berlin, München, Wien. 1912.

"Der Mensch der Vorzeit" very appropriately constitutes Volume I of a monumental work in three volumes[1] entitled "Der Mensch aller Zeiten Natur and Kultur der Völker der Erde."

By way of introduction the author gives a résumé of ancient cosmogony and archeology as seen through medieval eyes, and the founding of geology, paleontology and prehistoric archeology as exact sciences.

The key to the Glacial period is found in the existing glaciers, which still cover about 10 per cent. of the land surface of the earth. The author is particularly well qualified to treat of the geology of the Ice Age as he has made a special study of the glacial phenomena in the French Pyrenees, where he found a succession of four terraces in the Garonne and Ariège valleys precisely as had been noted previously by Penck and Brückner in the foothills of the Alps. These he refers to the four glacial epochs for which he accepts Penck's terminology, beginning with the oldest: Günz, Mindel, Riss and Würm. In the Garonne valley the Günz terrace is 150 meters above the present stream bed; while the Mindel, Riss and Würm terraces are 100, 55 and 15 meters respectively above the present stream.

The great loess mantel stretching from southern England, Belgium and northern France across Germany to the Carpathian Mountains, Obermaier considers an eolian formation. His conclusion is based on the position, structure and content of the loess. In the Riesengebirge it reaches an elevation of 400 meters above the sea; the lines of stratification are not such as would be formed in water; and the animal remains found in the loess are for the most part land shells, freshwater shells being rare and fishes entirely wanting.

While the great loess mantel is evidently eolian, there are restricted loess deposits connected with valley terraces that owe their formation to the agency of water. The loess of western and central Europe is exclusively of Quaternary age, but must be considered as having been deposited at various epochs. The author believes the latest loess to be post-glacial, while Penck would place it as far back as the maximum extension of the Würm glaciation.

The possible causes of the Ice Age may be classed as astronomical, geological and physical. The basis for the astronomical theories is that the movement of the earth is influenced not only by the sun, but also by the planets; the latter, although much smaller than the sun, are nevertheless able to bring about periodic changes in the form of the earth's orbit and the inclination of the earth's axis to the ecliptic. The precision of the equinoxes should also be considered. No one of the periodic changes in the movement of the earth is sufficient in itself to bring about a succession of glacial and interglacial epochs.

From the viewpoint of geology the legends concerning the lost Atlantis, or those pointing to a possible bridge across the north Atlantic, must ever remain purely legends. Does the theory of Kreichgauer furnish a key to the Ice Age? The author thinks favorably of it. Kreichgauer supposes the earth's axis to remain fixed and the earth's crust to move slowly on the molten mass within. Thus a spot on the equator might in the course of time find itself over one of the poles. Paleontology and the distribution of glacial phenomena are thought to offer evidences in support of this hypothesis.

As possible physical causes there may be cited changes in the character of the atmosphere, rendering it less penetrable by the sun's rays. According to Svante Arrhenius, a period of high percentage of carbonic acid in the air would be a period of cold, and *vice versa*. Periods of great volcanic activity would thus correspond to periods of cold; and the Quaternary volcanoes of Auvergne and the Rhine are known to have been active during a cold period. Of all the theories, the author gives preference to Kreichgauer's. Whether the glacial epochs were synchronous in the northern and southern hemispheres he is un-

[1] The authors of the other volumes are Ferdinand Birkner, Wilhelm Schmidt, Ferdinand Hestermann and Theodor Stratmann.

able to say categorically. That there were four glacial epochs alternating with interglacial epochs is reflected in the changing character of the animal and plant world. The association of animal and plant remains with human skeletal remains, and especially artifacts, often serves to throw light on the age of the latter.

The author divides the lower paleolithic into early Chellean, Chellean, Acheulian and Mousterian, describing in detail not only the well-known type specimens, but also various small forms only recently recognized as belonging to the earlier horizons. Many important stations are described at length; and ample space is given to the geographic distribution of the successive cultures.

The author traces diluvial man over practically the whole earth. He sifts the evidence bearing on the presence of diluvial man in countries outside of Europe, finding indications of a Chelleo-Mousterian industry widespread over both hemispheres. He believes it to be diluvial, but not necessarily everywhere of the same age.

The types characterizing the various upper paleolithic industries are fully described and figured: Aurignacian, Solutrean and Magdalenian, each with its subdivisions. The use of the Magdalenian *bâton de commandement* remains problematic. Of the many theories advanced as to the purpose it served, Obermaier favors Reinach's supposition that they might have been magic wands, rather than clubs, halter pieces, tent fixtures, figulæ, hunting trophies or sceptors. Of the Azilian epoch, transition epoch from the paleolithic to the neolithic, the fauna is neolithic, but the culture is still paleolithic. Breuil's conclusions as to the sequence in the development of paleolithic parietal art are accepted. Quaternary art in Europe is analogous to the art of modern primitive man, but not to that of neolithic man in Europe.

The popular interest in a definite chronology for man's antiquity is perennial. Authorities still differ enough in their estimates to admit of being grouped into three classes; radicals, conservatives and a middle class. The author would place the Magdalenian, not during the Achen retreat, nor after the Bühl stage, but during the latter because of the reindeer fauna. In that respect he and Penck are practically in accord, although Penck believes the Magdalenians were living somewhere also during the maximum Würm cold as well as during the Achen stage. By giving to the Magdalenians more latitude in point of time, Penck finds it convenient to push back the Mousterian epoch much further than Obermaier would have it go. Both believe that the Mousterians passed through a cold and a warm stage. Penck allows for this by placing the early Mousterians in the Riss glacial epoch and the later Mousterians in the first half of the succeeding Riss-Würm interglacial, and the upper Mousterian with the first advance and maximum of the Würm glaciation. Penck would have the Chellean and Acheulian correspond to the second interglacial epoch. Both agree in assigning the human lower jaw of Mauer to the Mindel-Riss interglacial epoch; the Mauer specimen thus represents for Penck Chellean man or pre-Chellean and for Obermaier pre-paleolithic man.

The difficulty of substituting an absolute for a relative chronology is at once evident to any one familiar with the character of the phenomena to be dealt with. The advance and retreat of glaciers has been studied in recent times. The rate of deposition and erosion within certain limits is subject to measurement. For a continental ice sheet to form and push its way out of the north until it reaches central Europe requires a long time; and it was not at once evicted from the outposts gained. Even after its maximum force was spent, it disputed stubbornly every inch of the territory on the retreat. This program with occasional halts and advances was repeated four times. The Würm glacial deposits look fresh in comparison to those of the Riss, for example, and still greater weathering is to be noted in the deposits left by the Mindel and Günz, respectively. The size of the Würm terminal moraine and the amount of material left as mantels on the retreat of

the ice, testify to the eroding and transporting power of the last glaciation, as well as to its long period of activity. The Riss terminal moraines and gravel beds are still greater; hence indicate a longer period of glaciation for the Riss epoch. If the various glacial epochs were of unlike duration, so also were the interglacial epochs. Penck finds that in the foothills of the Alps, where the gravel beds of the four glacial epochs appear as terraces, those of the first two epochs lie considerably higher than those of the last two. The valley erosion between the Mindel and the Riss epoch was, therefore, greater than that of the Riss-Würm interglacial epoch. On the other hand, the Riss-Würm is longer than the time that has elapsed since the maximum Würm extension. The alternation of cold and warm faunas confirms the theory of the relatively great length of time required. Since authorities do not agree as to the geological position of the various cultural epochs, it is not strange that they should also differ in their estimates concerning the absolute length of these epochs.

Obermaier admits that his own figures are ultra-conservative. He places the close of the neolithic age at about 2000 B.C., its beginning some 6000 B.C. The date separating the proto-neolithic from the Magdalenian is 12000 B.C., the beginning of the Magdalenian at least 16000 B.C. To the Solutrean and Aurignacian each he ascribes 5,000 years, and to the Mousterian, Acheulian and Chellean each 10,000 years. He thus arrives at a minimum figure of 50,000 years for the time that has elapsed since the appearance of paleolithic man, and at least 100,000 years for the age of the pre-paleolithic Heidelberg jaw.

L. Pilgrim is much more liberal in his estimates for a chronology of the Ice Age, his total amounting to 1,290,000 years. Penck's figures are somewhat more conservative; he allows some 30,000 years for the time that has elapsed since the maximum Würm glaciation, 60,000 years for the Riss-Würm epoch, more than 240,000 years for the Mindel-Riss epoch, and for the entire duration of the Ice Age 1,000,000 years. Hildebrandt's estimate for the Quaternary is 530,000 years. Schlosser and Boule are inclined to regard the Günz epoch as belonging to the upper Pliocene.

Obermaier rightly rejects all human remains whose age is in doubt. After this is done there is still left a formidable list representing every culture horizon. The Tilbury skeleton is thought to be of Quaternary age, while the remains from Galley Hill, Engis, Furfooz, La Hastière, Trou Magrite, Goyet, Trou du Chaleux, Brüx and Podbaba, are set aside as uncertain. He believes that we must go back to Eocene times in order to find the bridge that connects man with the ancestors of living anthropoids and cites *Pithecanthropus erectus* as an example of how close an anthropoid line can come to the human without being or becoming a part of it. *Propliopithecus hæckeli*, a fossil ape from the Oligocene of Egypt, is probably the ancestor not only of Simiidæ, but also of Hominidæ.

The eolithic question is discussed at considerable length. It is contended that on mechanical grounds alone there is no way of distinguishing between man-made and nature-made eoliths. The so-called Tertiary and Quaternary eoliths are not accepted unless they are made of material foreign to the deposit in which they are found, or are associated with human bones, hearths or other indubitable evidence of man's presence. On the other hand, it is admitted that some primitive races of to-day are in the eolithic stage, that all eoliths may not be due to natural causes, and that the lower jaw from Mauer represents eolithic man.

In Part II. the reader has a handy résumé of the culture periods connecting the paleolithic with historic times; neolithic, bronze and iron ages. It is, however, in Part I. that the author speaks with special authority and from a wealth of first-hand knowledge. Professor Obermaier is to be congratulated on the completion of a work that will be admired alike for its magnitude and general excellence.

George Grant MacCurdy
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The Meaning of Evolution. By SAMUEL CHRISTIAN SCHMUCKER, Ph.D. New York, The Macmillan Company. 1913. 12mo. Pp. 298.

This is a very readable book upon what is no longer a new theme. Following a literary "foreword" the pre-Darwinian history of evolution is sketched as a background for Darwin and Wallace. The historical chapter about Darwin presents the essentials of his career in a charmingly vivid and sympathetic manner. Then follows the "Underlying Idea" of natural selection as the method of evolution illustrated largely by means of the English sparrow, of which the author incidentally says (p. 84): "This pestiferous creature should be exterminated . . . but personally I am taking no share in his destruction . . . I confess that it would be with regret that I should see him disappear from the landscape."

Chapters IV. and V. deal with adaptation for the individual and for the species. The general attitude toward Lamarck is occasionally rather more conciliatory than the militant Weismannian would approve of, but this is not to be wondered at in one who is proud of having been a student of Professor Cope. It seems to be very easy to drop into Lamarckian explanations for adaptation. For instance (p. 89): "The modern scientist feels sure not only that the animal is fitted to his work, but that he has been so fitted by the work." It will probably always be a bone of contention whether the exercise of an organ determines its structure or the structure of an organ sets the limits to its exercise.

With respect to protective coloration and sexual selection the author proposes to retain the Darwinian interpretation until something better arises in spite of the recent loss of confidence in the adequacy of these explanations.

The three succeeding chapters upon "Life in the Past," "How the Mammals Developed," and "The Story of the Horse" marshal in review some of the classified evidence in support of animal evolution, while Chapter IX. takes up "Evolutionary Theories Since Darwin."

In this last chapter Weismann, whose name will doubtless be correctly spelled in subsequent editions, is justly given prominence because his "work has made us cautious and prevented our lightly accepting a belief in the influence of the environment." Moritz Wagner and Romanes with their isolation theories and the orthogenists receive attention, and finally Hugo deVries with mutation closes the chapter.

The book could have been written fifteen years ago so far as any analysis of the significant bearing which Mendelism or the pure-line theory of Johannsen has upon the question of evolution.

Chapter X. turns optimistically to the "Future Evolution of Man" and is sociological rather than biological in its treatment, while the final chapter, "Science and the Book" gives the impression that the professor has stepped out of the class room and is speaking to a church audience and speaking withal extremely well.

The word "Evolution" has lost most of its incendiary character of a generation ago yet there are no doubt many in whose minds it still stands contrasted with religion and the Bible as a faith-destroying invention of godless scientists. To all such persons this book is a welcome message of reassurance and peace while to others who no longer need to be convinced of the essential truth of the evolutionary processes, the pages will be turned with approving delight.

Dr. Schmucker has stated the facts of the case in clear non-technical language with much literary grace and with scientific accuracy, consequently the book is well adapted to a wide range of readers even outside the biologically initiated.

H. E. WALTER

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Animals of the Past. By FREDERICK A. LUCAS. American Museum of Natural History, Handbook series No. 4. New York. 1913. Pp. xx + 266, with a frontispiece and 50 full-page and text figures.

This volume is an exact reprint of Lucas's

"Animals of the Past," of which the last edition was published in 1902, with the addition of a prefatory note bearing a picture of the mounted skeleton of *Allosaurus* on the reverse side of the leaf, and a final chapter containing a retrospect of the last twelve years, and summarizing the latest additions to our knowledge, especially such as have been gained through the medium of exploration.

The printing is from the original plates, which ultimately became the property of the author, and the general appearance of the book, the paper cover of which bears Gleeson's spirited restoration of *Tylosaurus,* is of the degree of excellence which one is led to expect in publications of the American Museum.

Richard S. Lull

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A History of Chemistry from the Earliest Times to the Present Day. By the late James Campbell Brown, D.Sc., LL.D., Professor of Chemistry in the University of Liverpool. Philadelphia, P. Blakiston's Son & Co. 1913. Octavo. Pp. 558, with 107 illustrations. Cloth. $3.50 postpaid.

As stated by the editor (a cousin of the author) the present work comprises a course of lectures which the late Dr. Campbell Brown was accustomed to deliver before the chemistry students of Liverpool University. The lectures were left as manuscript notes which the author intended to revise for publication, but his sudden death in 1910 prevented the execution of this plan. Notwithstanding the imperfect shape of some of the material, the friends of the author considered that it would be a cause for regret if the information, which represented years of patient research and study were not made available to former students and to any others who might be interested in the history of chemistry. The lectures have, therefore, been printed, in much the same shape as delivered, the editor making such changes and revisions as seemed necessary for proper presentation in book form.

Following the example of Kopp (whose monumental "Geschichte der Chemie" must form a basis for every historian of chemistry) the author has divided his subject into five sections—the Prehistoric, the Alchemical, the Iatrochemical, the Phlogiston and the Quantitative Periods. The lectures upon the first four of these periods cover their ground most minutely, and indicate that the author must have had a particular fondness for ancient chemical lore. This section of the book is profusely illustrated with old drawings of alchemical apparatus, mystical diagrams and specimen pages of Greek, Syriac and Arabian texts. The lists of writers and of bibliographies are very full, making the book of service, both to those who wish to consult the old authors as well as to the collector of rare books. For the abundance of material supplied in this particular branch of chemical history, we know of no other book in English with which it can be compared.

In discussing the work of the ancient Greek and early medieval alchemists the author has made extensive use, as every historian of chemistry must, of the invaluable researches of Berthelot. The lecturer cautions his students to distinguish carefully between the genuine works of Democritus, Geber, etc., and those of their pseudo-namesakes; it seems that the editor has not heeded this caution in revising the late author's notes. The story told on page 30 of the miraculous opening which Democritus saw in the pillar of the temple at Memphis and the two prescriptions for making gold on page 31 are found in sections 3, 4 and 5, of the "Physica et Mystica," a work which belongs, as the author correctly states elsewhere (pp. 43, 182), to the pseudo-Democritus and not to the founder of the atomic school.

We fear that the remarks of the author upon page 14 regarding the chemical knowledge of the Hebrew law-giver Moses may cause considerable perplexity. The statement that Moses comminuted the golden calf and "rendered it soluble by fusion with an alkaline or alkaline-earthy sulphide" revives a strange speculation indulged in by the ancient alchemists. The verse in Exodus 32:20, which states that Moses took the golden calf "burnt it in the fire and ground it to powder and strewed it upon the water and made the

children of Israel drink it" stimulated the search for a life-giving tincture of gold (the *aurum potabile*). It was held that Moses possessed wonderful chemical knowledge, acquired from the Egyptians, and theories were advanced that he dissolved the golden image in *aqua regia* or else alloyed it with lead or mercury. Stahl in 1698 advanced the new explanation that Moses dissolved the gold by treatment with supersaturated liver of sulphur (*hepar sulphuris supersaturatum, ex æquis partibus salis alcali et sulphuris citrini*). From Stahl, evidently, the late author borrowed his own idea, which we can of course interpret only as a piece of lecture-room pleasantry.

The famous *ænigma chemicum* concerning the nine-lettered name of the philosopher's stone, which is translated in part on page 154, is another interesting example of the speculations in which alchemists were wont to indulge. The answer "arsenicon" which the author gives, is only one of many solutions that have been proposed; φαοσφόρος (phosphorus), κινάβαρις (cinnabar) κασίτερος (tin) and other Greek words have been distorted in a vain effort to meet the requirements of the riddle.

A critical reader might object to several statements in the book for reasons of inaccuracy. It is wrongly stated, for example, on page 17 that sugar was employed by the ancient Egyptians. The earliest reliable information—that found in old Chinese writings—places the probable date of the earliest manufacture of cane-sugar between A.D. 300 and 600. The σάκχαρ of Galen and σάκχαρον of Dioscorides and other Greek writers was not our modern cane-sugar, but in all probability the eastern *tabaschir*, a gummy silicious exudation of the bamboo.

The statement (p. 183) that Aristotle originated the idea of a fifth element (the ether or quintessence) requires to be modified. The same conception occurs earlier in Plato, who, in the Timæus (end of Chap. XX.), mentions a fifth substance or essence (ἕμπτη σύστασι), which included the four elements of fire, air, water and earth. This notion, which foreshadowed later assumptions concerning the unity of matter, is also found in the writings of the early Pythagoreans, from whom the idea was probably first borrowed.

The fifth section of the book was not finished by the late author and this part of the volume shows in consequence considerable evidences of incompleteness. Many of the chapters are in fact so fragmentary that a student can obtain only an imperfect and confused idea of modern chemistry. The chapter upon physiological chemistry, for example, makes no mention of the work of Claude Bernard and leaves the subject of fermentation where it was left by Dumas. The editor's arrangement of the author's lecture notes in this part of the book seems particularly unfortunate. We wonder, for example, in the grouping of chemists by chapters, why Wöhler was not associated with Liebig rather than with Stas, and why Bunsen was not placed with Kirchhoff rather than with Victor Meyer. There is also in places a lack of agreement between different sections. The discovery of columbium, for example, is credited to Wallaston in 1809 on page 348 and to Hatchett in 1801 on page 521. In some ways it would have been better to have closed the history with the end of the life-work of Liebig and Dumas. This marks fairly well the end of an epoch and would have enabled the editor to eliminate fragmentary chapters and thus give the book a greater appearance of finish.

The typography of the new book is, as a whole, excellent. The method of printing the formulas of propyl and isopropyl iodides on page 469 is faulty, as it gives them the appearance of being unsaturated compounds. There are also several cases of careless typesetting, a most glaring instance being the heading of chapter 32.

A posthumous work published under adverse conditions must necessarily receive due consideration for evidences of incompleteness and mistakes of revision. After a careful reading of the book, we believe that the publication of Dr. Campbell Brown's lectures upon the history of chemistry was well worth while. The finely

executed photograph of the author and the nine-page biographical sketch will be appreciated by those who knew him and to those unfamiliar with his life will convey the pleasing impression of a strong unique personality.

C. A. Browne

CHINA'S FOREIGN TRADE IN MEDIEVAL TIMES

The history of commercial intercourse, bound up as it is with the history of the origin and development of navigation, is a most fascinating subject, more especially the study of the commercial relations between the different Oriental peoples. A valuable contribution to this subject has recently been issued by Professor Friedrich Hirth, of Columbia University, and Mr. W. W. Rockhill. This is a translation from the Chinese, with introduction and commentary, of the work by Chau Ju-Kua, treating primarily of products, and incidentally of the customs of the various countries known to the Chinese in the twelfth and thirteenth centuries of our era. The introduction by the translators supplies us with much valuable information on Chinese trade derived from a number of other sources.[1]

Of the many interesting facts to be gleaned from a perusal of this book, we can only very briefly touch upon a few of the more striking. The work appeals especially to careful and thorough students of the subject.

The trade of Canton was the object of earnest solicitude to the Chinese government, because of the large revenue derivable from it. One of the port regulations implies a determination to give all importers an equal chance, as far as possible, for as each ship arrived its cargo was discharged, and the merchandise placed in the government storehouses and kept there until the last ship of the season sailed in. Only then were goods placed at the owners' disposal for sale, the government retaining thirty per cent. as customs duties. Thus the first comer was not allowed to secure the cream of the market to the prejudice of those who might have had a longer voyage, or else have been detained by stress of weather.[2]

Toward the close of the tenth century the Chinese government, realizing the great value of its Canton trade, undertook an active propaganda to encourage its development, envoys being despatched with the wherewithal to secure the good-will of the South Sea traders. Among other inducements special trading licenses were offered. The results were soon apparent, merchandise poured in so freely that the difficulty was to find a good market for it. The rapid increase under this fostering care is shown by the fact that while from 1049 to 1053, elephants' tusks, rhinoceros horns, strings of pearls, aromatics, incense, etc., were annually imported to the value of 53,000 "units of count," these annual imports had risen in 1175 to over 500,000 "units of count." While the monetary equivalent is an unknown quantity, the figures suffice to show the great increase of the Canton trade.[3]

The government import duties amounted to thirty per cent. from the middle of the ninth century A.D. and this rate remained practically unchanged for several centuries thereafter. If any part of a ship's cargo was removed without the knowledge of the officials the whole cargo was confiscated and the offender was punished according to the gravity of the offense. Therefore we need not wonder that a Chinese authority (the Pingchou-k'o-t'an) should be able to state: "so it is that traders do not dare to violate the regulations."[4]

The Chinese author does not confine himself to a description of the chief productions of each of the regions he passes in review, although this is the principal aim of his work, but he also gives many brief notes regarding the customs, dress, etc., of the different peoples and details of the court ceremonials.

[1] Chau Ju-Kua = his work on the Chinese and Arab trade in the twelfth and thirteenth centuries, entitled "Chu-fan-chi." Translated from the Chinese and annotated by Friedrich Hirth and W. W. Rockhill, St. Petersburg, Printing Office of the Imperial Academy of Sciences, 1911. Pp. x + 288. 8°.

[2] *Op. cit.*, p. 15.

[3] *Op. cit.*, p. 19.

[4] *Op. cit.*, p. 21.

Of the Annamese we learn that the king usually rode on an elephant when he appeared in public; sometimes he was borne in a sort of hammock by four men. At court ceremonies his throne was surrounded by thirty female attendants, armed with sword and buckler. A curious custom in warfare was to bind five men together in one file; if one tried to run away the whole file was condemned to death.

The implicit faith in the virtue of written charms is illustrated by the proceedings to be taken when one of the people was killed by a tiger or a crocodile. In this case the high priest was ordered to write out a number of charms and scatter them about at the spot where the person was killed. Such was believed to be the power of the charm that the guilty animal would be invariably attracted to the place, but before he could be done away with, a royal order had to be secured.[5]

The jewel treasures of Ceylon always excited the wonder and admiration of the early travelers to that island, and Chau Ju-Kua is no exception to this rule. His description of the king's personal appearance is scarcely flattering. He is black, with unkempt hair and bare head, his body only covered with a cotton cloth of various colors wound about him, but of his abode we read:[6]

"His palace is ornamented with cat's-eyes, blue and red precious stones, carnelians and other jewels; the very floor he walks upon is so ornamented. There is an eastern and western palace, and at each there is a golden tree, the trunk and branches all of gold, the flowers, fruit and leaves of cat's-eyes, blue and red precious stones, and such like jewels. At the foot of these trees are golden thrones with opaque glass screens. When the king holds his court he uses the eastern palace in the forenoon and the western in the afternoon. When (the king) is seated, the jewels flashing in the sunshine, the glass (screens) and the jewel-trees shining on each other, make it like the glory of the rising sun.

"The king holds in his hand a jewel five inches in diameter, which can not be burnt by fire, and which shines (in the darkness of) night like a torch. The king rubs his face with it daily, and though he were passed ninety he would retain his youthful looks."

The throne of the king of Cambodia was made of "the seven precious substances," with a jeweled dais and an ivory screen. He was said to have 200,000 war elephants—a glaring exaggeration—and four large bronze elephants, each weighing 4,000 catties, stood as guards about a bronze tower or temple in the capital.

A strange test of true royalty is noted in Palembang, eastern Sumatra. Here the royal cap was of gold, studded with hundreds of precious stones, and of such crushing weight that few were able to wear it. On a king's demise all his sons were summoned together and the one who proved strong enough to bear the weight of this cap was proclaimed as the new sovereign.

The few details we have cited from this work will give some idea of the interest and value of the volume, and the full and scholarly notes with which it has been so liberally provided by its translators and editors add much to its worth as a book of reference.

GEORGE F. KUNZ

[5] *Op. cit.*, pp. 47, 48.

[6] *Op. cit.*, pp. 72, 73.

SPECIAL ARTICLES

FURTHER EXPERIMENTS ON OVARIAN TRANSPLANTATION IN GUINEA-PIGS

FOR several years we have been engaged in studying the effects of ovarian transplantation upon the inherited color characters of young guinea-pigs developing from eggs liberated by a transplanted ovary. Our method has been to transplant the ovary taken from an animal of one color variety into the body of an animal of a different color variety and then to observe whether the young showed the color characters of the mother which bore the young or of the animal which furnished the ovary, or of both. In 1909[1] we reported the first crucial experiment bearing on this ques-

[1] "A Successful Ovarian Transplantation in the Guinea-pig and its Bearing on Problems of Genetics," SCIENCE, N. S., Vol. 30, pp. 312–314. 1909.

tion, which was more fully described with illustrations in 1911.[2] In a postscript to our 1911 publication we described a second crucial case, and it is the purpose of this note to record a third.

In the first case, the ovaries of a black guinea-pig were transplanted into the body of a white one, where they developed and liberated ova for a period of more than one year, in the course of which six young were produced, all black-coated like the animal which furnished the ovary, but not like the animal which bore the young. The foster mother differed from the animal which furnished the graft, to the best of our knowledge, by only a single genetic color factor. The ovarian tissue taken from the black animal evidently possessed this factor (the so-called "color-factor") and retained it throughout its sojourn in the body of the albino, for it was transmitted in the eggs liberated within the body of the albino, a thing which never occurs in normal albinos.

In the second case, as in the first, the same color-factor difference existed between the animal which furnished the graft and the one which received it, the latter being an albino, the former colored, while as regards other color-factors graft and grafted were alike. But in Case 1, as already stated, the colored animal was black and the albino was a *potential* black, lacking color; whereas in Case 2 the colored animal was brown-eyed cream and the albino was a *potential* brown-eyed cream, lacking color. In the pair of animals used in Case 1 two color-factors occurred which were lacking (or different) in Case 2. In Case 1 *black* and *extension* of color were present in graft and grafted animal alike; in Case 2 these were replaced by *brown* and *restriction* respectively. Nevertheless the same negative result was observed in both cases as regards the effects of grafting. In Case 2, the grafted albino foster mother bore a brown-eyed cream young one by an albino mate. She also bore two albino young, but this is not to be regarded as evidence of somatic influence of the foster mother, for it is known that animals of the stock of guinea-pigs which furnished the graft were heterozygous in albinism, so that the ovarian tissue would be expected to furnish equal numbers of ova transmitting the brown-eyed cream character and albinism, respectively. As we said in 1911, "The character of the young obtained and their numerical proportions are exactly such as the colored animal herself would have been expected to give had she not been sacrificed to furnish the grafts but had been mated with the albino male."

The third (and new) case involves a wholly different factor, the *agouti* hair pattern, both animals being colored and alike, so far as known, in all genetic factors except the agouti. For both were *brown* pigmented (not black), with *extended* (not restricted) pigmentation, and in the families of both albinism occurred as a recessive character. The grafted animal in this case was a brown (or "chocolate") animal, No. 2,562. Her parents were of the same color. At about six weeks of age, on June 9, 1910, she was castrated and then received the ovaries from female No. 2,564, a light cinnamon guinea-pig about one month old, and of the same color variety as her parents. On either side of the body an ovary was stitched to the "horn" of the uterus about a centimeter from the normal position of the ovary. After recovery the grafted animal was placed in a pen with male 2,420, an albino whose parents were brown-eyed cream. From a mating with this animal the expectation would be that a brown mother would produce brown young (or albinos potentially brown), while a cinnamon mother would produce cinnamon young (or albinos potentially cinnamon).

The grafted mother produced five young as follows: In November, 1910, a male albino; on June 25, 1911 (more than a year after the operation), a female light cinnamon, No. 2,986; on September 1, 1911, a male light cinnamon-and-yellow, No. 3,016; on November 10, 1911, a male albino; on January 29, 1912, a female albino.

[2] "On Germinal Transplantation in Vertebrates," Carnegie Institution of Washington, Publ. No. 144, 26 pp., 2 pl. 1911.

On July 15, 1912, over two years after the operation, the grafted mother was noted as still having well-developed mammæ and genitalia, as if she possessed functional ovarian tissue. On November 25, 1912, she died and there was found *post mortem* a large cyst in the uterus on the right side, and on the left side at the site of the graft a large ovarian mass, doubtless the source of the functional ova liberated during the two years previous. No microscopic study of this tissue was made, as it was already in an advanced stage of decomposition when observed.

To summarize the record, two of the five young were colored, and three were albinos. Both of the colored young were cinnamon, like the graft producer, rather than brown like the foster mother. As regards the albinos, it remained to ascertain whether they were *potential cinnamons* or *potential browns*. This required a breeding test which we were able to complete in the case of one of the three only. This animal, a male, when mated with brown females, produced two brown and one cinnamon young, showing that he was potentially a cinnamon though heterozygous for brown. He had accordingly inherited cinnamon from his foster mother, or rather from the graft which she contained, for his albino father did not transmit cinnamon. This could be inferred from the fact that the brown-eyed cream ancestors of the albino father were known not to transmit cinnamon, but it was further established by mating him with brown females, by which he produced five brown young and two albinos but no cinnamons.

If, as stated, the albino father, No. 2,420, did not transmit cinnamon, then his cinnamon offspring, or *potential cinnamon* albino offspring, by the grafted brown mother, would have to be merely *heterozygous* in cinnamon. Therefore, we should expect only half of *their* young to be cinnamon, when they were mated with brown animals. The potential cinnamon albino, as already noted, when so mated, had one cinnamon and two brown young.

Finally, the cinnamon female, No. 2,986 borne by the grafted mother, was mated with her albino father (*potentially* a brown-eyed cream, since his parents were of that recessive variety). She produced eight young, of which five were brown-eyed creams, two albinos and one a cinnamon; expectation 2:4:1. The production of a cinnamon young one in this mating shows that the cinnamon animal not only inherited but also transmitted the cinnamon character, as if her mother had been a cinnamon animal instead of a cinnamon graft in a brown animal. The sojourn and development, in the body of a brown animal, of an ovary taken from a cinnamon animal does not seem to have altered in any respect the initial genetic potentialities of the germinal substance.

These three cases form a substantial body of evidence in favor of the view originally advanced by Weismann that in the higher animals germinal substance and body are physiologically distinct, and that the genetic potentialities of the latter are not subject to modification through somatic influence.

It may be of interest to note that in our entire work 141 female guinea-pigs were grafted with foreign ovaries. Of these about 100 were mated with males long enough to give definite indications of their ability to produce young. Only 3, as noted, actually produced young, but in 7 others engrafted ovarian tissue persisted for many months and was demonstrated *post mortem*. In 11 cases ovarian tissue was regenerated at the original ovarian site and in 3 of these cases young were produced having the genetic characters of the mother, but never those of the graft. In 87 cases no ovarian tissue whatever was found *post mortem*, the castration having been completely successful but the transplanted ovaries having failed to persist for any length of time in the foreign body.

The small percentage of successful transplantations indicates that the method is not likely to be useful practically in the domestic animals or man unless some means can be discovered for increasing the tolerance of the body to foreign tissues. We have considered in this connection the possibility of increasing this tolerance by holding the tissue to be

transplanted for a time in an artificial nutrient medium or even in serum from the animal to be grafted, allowing thus a preliminary adjustment to the new environment, but have had no opportunity to give such methods a trial. They are mentioned as possible suggestions for some one who may be able to attack the problem fully equipped with a knowledge of the principles governing immunity and anaphylaxis.

This investigation has been carried out in the Bussey Institution with assistance from the Carnegie Institution of Washington.

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Nutrition and Sex Determination in Rotifers

In an interesting paper in the August, 1913, number of the *Journal of Experimental Zoology,* Claude W. Mitchell communicates a series of observations and experiments upon the rotifer *Asplanchna,* from which he draws conclusions at variance with those hitherto advanced by investigators who have worked with *Hydatina.* His main conclusion, it appears to me, is that "qualitative and quantitative changes in nutrition will be found the universal sex-controlling factor in this group" (rotifers). If it be granted that other factors than nutrition also play the same role in sex determination in one rotifer as in another, I think it may be shown that Mitchell's experiments are not calculated to prove his contentions.

There is, in the first place, some obscurity in the use of the word "nutrition." By the earlier workers on life cycles in rotifers and daphnians, nutrition was measured by the quantity of available food. The rate of reproduction gave a key to the degree of nutrition, but the rate of reproduction was supposed to be proportional to the amount of available food. It is obvious, however, that nutrition may be measured by the quantity of food that an organism can *assimilate,* which may be independent of the amount *available.* In rotifers, for example, there are periods in which reproduction and growth are rapid, alternating with periods in which these processes are slow. Mitchell does the service to emphasize this "physiological rhythm." Rotifers in the period of rapid growth will live well under external food conditions that would reduce rotifers in a period of depression almost to starvation.

When we say that nutrition determines sex, what meaning do we put upon nutrition? One might assume that Mitchell regards nutrition and physiological "level," to use another term of his, as synonymous, were it not that in the seventh paragraph of his summary he lists them separately. To quote:

> Maximum male production is determined by three factors, physiological rhythm, high nutrition and starvation during the growth period.

If nutrition means the quantity of food available, the evidence in its favor as a sex determinant is so small as to be negligible. The experiments of Mitchell do not prove its effectiveness in *Asplanchna,* as I hope to show below, and my own work on *Hydatina* is not only distinctly against it, but explains away the positive results of Nussbaum. If nutrition means the quantity of food that can be assimilated, then high nutrition is probably the result of an antecedent physiological change that is not nutrition at all. Rhythms of reproduction and growth occur in *Hydatina,* in protozoa, in *Cladocera,* and perhaps many other animals; but so far as I know, the physiological change preceding a wave of rapid growth has not been discovered. It may be a chromosomal change. If the wave of rapid reproduction is accompanied by a wave of many male producers, it seems to me we are much more justifiable in assuming that both high nutrition and male production are here the result of some other physiological factor, than in holding the male production to be a result of the nutrition. That the evidence of high nutrition comes earlier in a series of generations than does the evidence of male production may be due to the fact, true at least for *Hydatina,* that sex is determined a generation in advance without any visible sign of such determination. I revert to this point,

apparently overlooked by Mitchell, below in another connection.

If my interpretation of physiological rhythm be correct, as outlined in the preceding paragraph, nutrition and male production stand in the relation, not of cause and effect, but of two effects of some cause. If this interpretation is correct, high nutrition and male production are not inseparable; and there is evidence that they are separable. Early in my work on *Hydatina* I noticed that periods of abundant male production were also periods of rapid growth (the fact which Mitchell emphasizes for *Asplanchna*), and I was almost convinced that anything which increased metabolism would also increase the proportion of male-producers.[1] But in healthy lines I later found that long periods were passed through in which the rate of growth and reproduction was very rapid, yet not a single male-producer appeared. In one instance, there were twelve successive generations in which no family comprised less than 46 daughters, some of them over fifty, which is almost the maximum of all my records. At the same time the females laid 16 to 22 eggs per day, depending on temperature, quite as rapidly as in the waves in which I had previously noted large numbers of male-producers. Yet not one male-producer appeared in these twelve generations. Hence, when actual counts were made from numerous families, for the purpose of proving that rapid metabolism and male production were interdependent, that thesis could not be established. While periods of many male-producers were on the whole periods of rapid metabolism, not every period of rapid metabolism was a period of many male-producers. Rapid metabolism could occur without abundant male production. One is driven, it seems to me, to the conclusion that when male production and rapid assimilation ("nutrition") occur simultaneously, both are probably effects of one cause; but that rapid assimilation may have other causes which do not at the same time cause abundant male production.

Mitchell does not, however, rely wholly upon the high nutrition which accompanies physiological rhythm to explain male production. The "nutrition" which depends upon the available supply of food is also held accountable; for the author conducts experiments in which the food supply is altered, and obtains what he believes to be positive results thereby. The general conclusion from these nutrition experiments is that "male production follows upon the summation of favorable external and internal conditions, plus a sudden interruption by a nutritive check." This check is starvation. The experiments, however, appear to me, for reasons about to be stated, quite inadequate. For example, one experiment consisted in isolating females from periods of rapid metabolism and from periods of depression, starving their offspring for a period after birth, and noting whether the daughters were male- or female-producers. Each part of this experiment involved only about ten individuals. Notwithstanding great irregularities in the occurrence of male-producers, irregularities which the author admits sufficiently to explain certain exceptions, the ten individuals are considered valid evidence. The apparent lawlessness of the occurrence of male-producers is sometimes astonishing. In *Hydatina,* in an extreme case, two sisters, the fourth and fifth, respectively, in their family, reared under what were aimed to be identical conditions, each produced a family of over forty. One family comprised over fifty per cent. of male-producers, the other none at all. In view of such irregularities, experiments including less than eight or ten generations have in my work been regarded with suspicion, unless the effects were quite marked. If such irregularities in the occurrence of male-producers are found in *Asplanchna,* ten individuals do not form a basis for conclusions.

Furthermore, it is questionable whether starvation can have such an effect *on the individual starved* as to change a female-producer to a male-producer. I have shown for *Hyda-*

[1] So nearly convinced was I that this relation existed, that I expressed the idea before a public gathering at the laboratory of the Brooklyn Institute of Arts and Sciences at Cold Spring Harbor, in the summer of 1909, but never in any published work.

tina[2] that it is irrevocably decided during the growth period of an egg whether the female that hatches from that egg will be a male-producer or a female-producer. This is actually proved, it is true, only so far as the effect of chemical substances is concerned. But I am unable to take comfort in the view that sex is determined at a given moment beyond the possibility of reversal by chemical substances, while it is still open to alteration by other external agents. If sex is determined thus a generation in advance in *Asplanchna,* as in *Hydatina,* the starvation experiments referred to above could not have produced positive results; the starvation should have been practised on the mother of the desired male-producer.

In another experiment Mitchell starves a number of young females for a few hours after birth. The first few daughters in each of nine families are used as controls (well fed); they include six male-producers out of a total of 39. The later daughters of the same families are starved; 51 out of 68 prove to be male-producers. The author attributes the higher proportion of male-producers in the latter lot to the check upon nutrition. But, waiving the objection of a rather small number of individuals, another explanation is at hand. It has been shown[3] from 349 families of *Hydatina,* comprising about twelve thousand individuals, that the first few daughters of a family are much less likely to be male-producers than are the later members. If the same relation holds in *Asplanchna,* the numbers of male-producers obtained in the experiment described are about what would have been expected if starvation had not been practised.

In offering this criticism of Mitchell's work I do so in no carping spirit. It is gratifying to find some one using the excellent material which *Asplanchna* affords in an attempt to solve fundamental problems. I have sought only to show wherein lie the weaknesses of the evidence.

A. Franklin Shull
University of Michigan

[2] Shull, A. F., "Studies, etc., III. Internal Factors Affecting the Proportion of Male-producers," *Jour. Exp. Zool.,* Vol. 12, No. 2, February, 1912.

[3] Shull, A. F., "Studies, etc." I., *Jour. Exp. Zool.,* Vol. 8, No. 3, May, 1910.

THE AMERICAN PHYSICAL SOCIETY

A regular meeting of the Physical Society was held in Fayerweather Hall, Columbia University, New York City, on Saturday, October 18, 1913. The following papers were presented:

"The Vapor Pressure of Metallic Tungsten," by Irving Langmuir.

"The Form of the Ionization by Impact Function, $a/p = f\ (x/p)$," by Bergen Davis.

"Change of State Solid-liquid at High Pressure," by P. W. Bridgman.

"Notes on Some Integrating Methods in Alternating Current Testing," by Frederick Bedell.

"Silvered Quartz Fibers of Low Resistance Obtained by Cathode Spray," by Horatio B. Williams.

"The Critical Ranges A_2 and A_3 of Pure Iron," by G. K. Burgess and J. J. Crowe.

"A Spectrophotometric Study of the Absorption, Fluorescence and Surface Color of Magnesium Platinum Cyanide," by Frances G. Wick.

"Examination of the Omnicolored Screen Plate by Means of Microscope and Spectroscope," by John B. Taylor.

"Relativity Theory—General Dynamical Principles," by Richard C. Tolman. (By title.)

"The Hall Effect in Liquid and Solid Mercury," by W. N. Fenninger.

"An Electrolytic Determination of the Ratio of Silver to Iodine and the Value of the Faraday," by G. W. Vinal and S. J. Bates.

"Effect of Amalgamation on the Contact E.M.F. of Metals," by F. J. Rogers.

"Relativity Theory; The Equipartition Law in a System of Particles," by Richard C. Tolman. (By title.)

"Failure of Color Photography by Commercial Screen-plate Methods for Spectroscopic Records," by John B. Taylor.

"Condition Involving a Decrease of Primary Current with Increasing Secondary Current," by F. J. Rogers.

"Experiments on the Magnetic Field of Two Electromagnets in Rotation," by S. J. Barnett.

"The Effect of Space Charge and Residual Gases on the Thermionic Current in a High Vacuum," by Irving Langmuir.

Alfred D. Cole,
Secretary